CANADA/MANITOBA

JOINT FOREST RESEARCH COMMITTEE

FORESTRY RESEARCH PLAN FOR MANITOBA

1984-89

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NOVEMBER, 1984

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FOREWORD

This report is a compendium of data, information, techniques and funding levels that have evolved after a series of meetings and discussions by the members of the Joint Canada/Manitoba Forest Research Committee. This Committee was established to implement the Memorandum of Understanding on Co-ordination of Forest Research and also serves as a subcommittee under the Canada/Manitoba Forest Renewal Agreement. The research and development needs have been reflected in the formulation of 10 program areas in various disciplines of forestry. These will be implemented over the five year period, 1984-89.

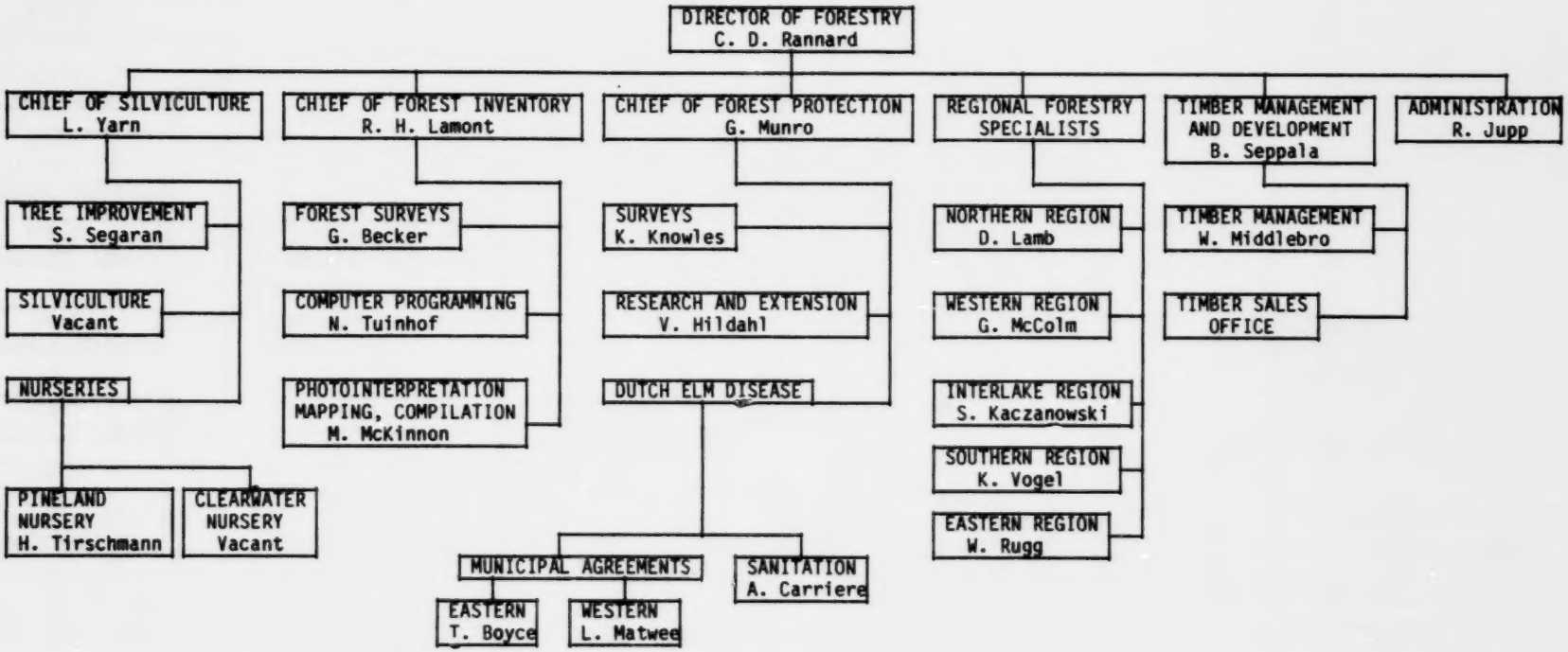
Both short and long term operational benefits have been taken into consideration in designing the experiments to be researched. The Canada/Manitoba Forest Renewal Agreement will result in the creation of employment opportunities and the hiring of professional, technical and administrative support staff.

It is intended and required under the forest renewal agreement that quarterly and annual reports will be made on project progress and monies expended in the delivery of the 10 program areas.

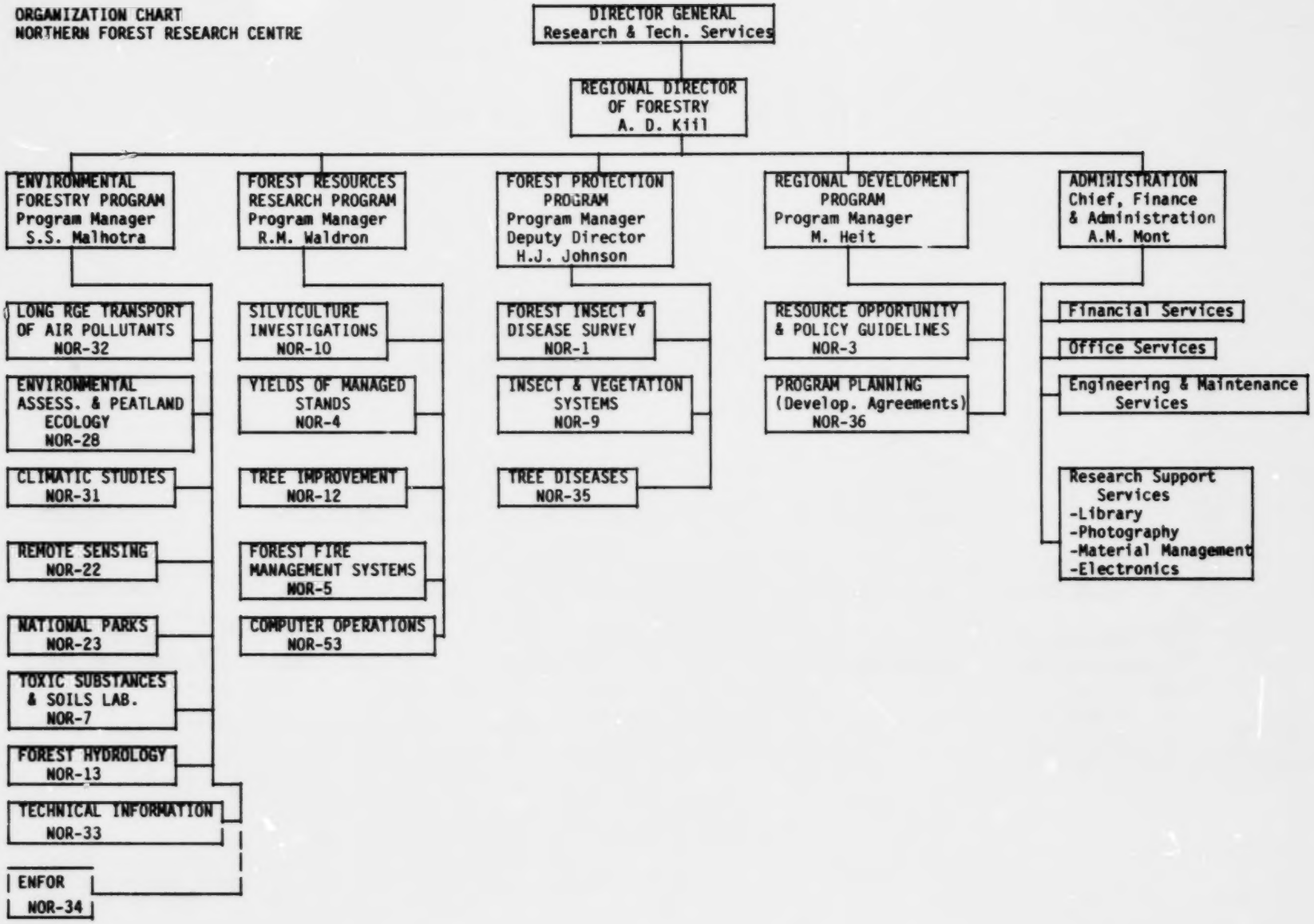
ABBREVIATIONS USED

CFS	=	Canadian Forestry Services
CLI	=	Canadian Land Inventory
CM	=	Canada/Manitoba
CMJFRC	=	Canada/Manitoba Joint Forest Research Committee
DED	=	Dutch Elm Disease
EMD	=	Environmental Management Division
HBM&S	=	Hudson Bay Mining and Smelting
IBMPC	=	International Business Machines Personal Computer
INCO	=	International Nickel Company of Canada
LRTAP	=	Long Range Transport of Air Pollutants
MANFOR	=	Manitoba Forestry Resources Limited
MFMP	=	Manitoba's Forest Management Plan, 1981-2000
MNR	=	Manitoba Natural Resources
NoFRC	=	Northern Forest Research Centre, Edmonton
PY	=	Person Year
R & D	=	Research and Development
WSA	=	Weather Station Area
TT	=	Technology Transfer

ORGANIZATION CHART
MANITOBA NATURAL RESOURCES
FORESTRY BRANCH



ORGANIZATION CHART
NORTHERN FOREST RESEARCH CENTRE



1.0 INTRODUCTION

This section is divided into three sub-sections, namely, (a) History of forestry and forest management research in the Province of Manitoba, (b) Forest management research in Manitoba undertaken by the Canadian Forestry Service, and (c) The status of current operational forestry research in Manitoba.

1.1 History of Forestry and Forest Management Research in the Province of Manitoba

The history of forest utilization dates back to 1670 when wood was used in a variety of forms by native Indians, for weapons and tools, for lodging, shelter, heating and cooking, and for transportation. In the case of the latter, the native Indians contributed three important articles, namely the birch bark canoe, the snowshoe and the toboggan. One of the main uses of wood was for cooking and heating purposes.

From 1670 to 1811 the Province, the area as it was known then, was owned by Hudson's Bay Company as part of their territory of Rupertsland. The charter granted by Charles II in 1670 gave the Company exclusive possession of all the lands draining into Hudson Bay. In 1817 Lord Selkirk secured the title from the Hudson's Bay Company to what was known as the District of Assiniboia. The settlers were allowed to cut timber free of dues for their own use, and also for public works purposes.

For a period of sixty-three years from July 15, 1870 to July 15, 1933 the natural resources of Manitoba were under federal jurisdiction. Enactment of the first Dominion Lands Act of 1872 gave

all aspects of forestry administration to the Department of the Interior. Timber disposal under this Act was by two methods, licenced berths and permits. In 1911 the Forest Reserves and Park Act was enacted by which the administration of licenced timber berths inside forest reserves was taken away from the Forestry Branch and handed over to the Timber and Grazing Branch. At this point in time, the forest reserves were comprised of Porcupine, Spruce Woods, and the Turtle, Duck and Riding Mountains.

When the Province took over all aspects of forestry administration in 1930 under the Provincial Forestry Act of March 12, 1930, there were six forest reserves with a total of 9,954 sq. km as follows:

RESERVE	AREA (SQ. KM.)	ESTABLISHMENT DATE
Riding Mountain	2,896	1895 as Timber Reserve 1906 as Forest Reserve 1933 as National Park
Turtle Mountain	283	1895 as Timber Reserve 1906 as Forest Reserve
Spruce Woods	582	1895 as Timber Reserve 1906 as Forest Reserve
Porcupine	1,994	1906 as Forest Reserve
Duck Mountain	3,708	1906 as Forest Reserve
Sandilands	491	1923 as Forest Reserve
Total Area	9,954	

A Provincial Forester headed the Forest Service with four District Foresters, each heading a Forest District. The Forest Districts were again divided into Ranger Districts each with a Forest Ranger.

In 1931, the "Whiteshell" Forest Reserve of 2,470 sq. km. was created in the Eastern District. Progressively Cormorant Forest Reserve was established in 1947, Sandilands extension of 1,490 sq. km. in 1950, Agassiz and Belair in 1954 and North West Angle Forest Reserve in 1956.

During the period 1904-1929 local forest tree nurseries were constructed at Shilo in the Spruce Woods, Marchand in the Sandilands, Lake Max in the Turtle Mountain and Birch River in the Porcupine. In 1949 Carberry replaced Shilo as the main nursery. In 1953 all nurseries were abandoned, and replaced by the Pineland Nursery, and by the fall of 1958 stock in the nursery totalled 8,790,000 seedlings and transplants.

The first forest experiments were initiated in 1924 with the thinning of Jack Pine in the Riding Mountain and the cutting methods for White Spruce in the Pasquia Hills. When the forest resources were turned over to the Province in 1933, the Dominion Forest Service assumed responsibility for forest research. Progressively the Riding Mountain Forest Experimental Area was established in 1940 and during the period 1952-1967 a Federal/Provincial Forestry Agreement was signed to enhance forest management and protection.

In 1970 the Federal Winnipeg Research Office was closed and the Province assumed the responsibility of major areas of forest research in 1971 though CFS continued to undertake skeletal research and development in Manitoba from Edmonton. From 1976 the conduction of applied forest research has culminated in the establishment of spruce seed orchards, development of seed zones, scientific formulation of

cultural and fertilization schedules for raising containerized stock. This was made possible by the construction of the first modern tree improvement greenhouse with stringent genetic environment in 1977.

The Federal/Provincial Renewal Agreement signed in 1984 will further see professional expertise flowing through for the expansion and enhancement of forest renewal efforts and forest management and tree improvement research in the Province.

1.2 Forest Management Research in Manitoba Undertaken by the Canadian Forestry Service

Records indicated that the first research study undertaken in Manitoba by the Canadian Forestry Service (CFS) or its predecessors was a Jack Pine thinning experiment in 1924 in the Riding Mountain Forest Reserve by C.B. Gill. However, coniferous plantations established in the Spruce Woods, Turtle, Duck and Riding Mountains between 1904 and 1929 have since been used extensively for research into growth and yield.

In 1933 the forest resources of the Province were transferred from the Federal Department of the Interior to the Province of Manitoba and the Canadian Forestry Service assumed responsibility for research into forest management practices. Due to the "Dirty 30's" and the depression which followed there were few, if any, research staff on strength. The Canadian Forestry Service's role during this time was related to a large program of shelterbelt and farmbelt plantings, particularly in the Lyleton area of southwestern Manitoba and the supervision of forestry job creation programs in the Riding Mountain National Park.

In 1937 the Duck Mountain Forest Experimental Area was established near Singoosh Lake. A number of thinning and conifer release studies were undertaken before the experimental area was closed in 1939 due to forest fires. The Riding Mountain Forest Experimental Area was established in 1940 but again no research staff was available due to the start of World War II. The Winnipeg office of the Canadian Forestry Service expanded from a staff of one during the war years to a staff of 10 in the mid 1950's. Research efforts during the period were related to site classification for silviculture practices and productivity including growth and yield studies in Jack Pine and White Spruce-Aspen. Research was also undertaken in harvesting techniques for the natural regeneration of Black Spruce, White Spruce, Jack Pine and Red Pine. Small experiments were undertaken in plantation establishment and broadcast seeding. Studies were also undertaken to determine ecological relationships; factors affecting the natural regeneration of White Spruce, Black Spruce, and Jack Pine; experiments were carried out using a variety of scarification equipment and studies to assess the usefulness of herbicides for controlling competing vegetation were undertaken. Thinning experiments were carried out in Jack Pine and Trembling Aspen stands as were release studies in mixed White Spruce-Aspen stands.

Between 1952 and 1967 a Canada/Manitoba Forestry Agreement was in place through which the federal and provincial forestry services supported (on a 50:50 basis) operational forest management practices including inventory, silviculture, fire protection, and construction of forest access roads. The Pineland Forest Nursery at Hadashville was

established under this program.

In 1965 entomology and pathology research staff and the Forest Insect and Disease Survey (FIDS) of Agriculture Canada joined the Federal Forestry Branch office in Winnipeg. Research undertaken included studies on the biology and control of major forest pests including Spruce Budworm, Jack Pine Budworm, Forest Tent Caterpillar, Larch Sawfly, Jack Pine Mistletoe and June Beetle Larvae. A host of other forest and amenity insects and diseases were also studied. Towards the end of the 60's Dutch Elm Disease became a problem of major proportion for which research and identification services were provided to the Province. General insect dynamic studies were undertaken by FIDS but only a few impact studies were initiated.

By the mid 1960's staff of the Canadian Forestry Service in the Manitoba-Saskatchewan Region numbered 120 persons. The Research and Development (R & D) program expanded exponentially while technology transfer became a program of high priority. New R & D undertaken included tree improvement programs in Jack Pine, White Spruce, and Poplar. In-depth insect studies were undertaken on Larch Sawfly, and plantation insects. Disease studies included those of White Spruce (Butt rot) and Aspen (decay). A multidiscipline project was established to undertake R & D in shelterbelt management with some emphasis on landscape ecology.

Silviculture R & D included the use of prescribed burning in Jack Pine and White Spruce-Aspen cutovers. A variety of regeneration techniques, including natural, planting, and broadcast seeding in a variety of cover types were carried out. In-depth ecological studies

continued on Aspen, White Spruce, and Jack Pine in order to develop successful silviculture prescriptions for a range of site and cover types. A forest nursery R & D program was initiated. Land classification systems efforts were intensified but failed to yield a province-wide system. Silvicultural prescriptions and stand yield interpretations were prepared for a number of the Manitoba Soils Surveys map sheets.

A large number of individuals worked in the Liaison and Services program whose task was to undertake short term research to resolve provincial and industrial forest management problems and to carry out a technology transfer function to ensure that R & D findings were applied by forest land managers and that significant R & D problems were being addressed by CFS research staff.

In 1970 the Winnipeg (Manitoba-Saskatchewan Region) office was closed and staff from Winnipeg and Calgary went to Edmonton to form the Northern Forest Research Centre (NoFRC). A small sub-office was maintained with a staff of 6 whose role was liaison, technology transfer, and extension. This office was closed in 1978 and re-opened in 1979 with 1 person in the liaison function.

Reduced budgets severely constrained the R & D program at NoFRC although efforts were made to undertake research relevant to the needs of the three Prairie Provinces. However, these efforts fell short in terms of specifically addressing Manitoba's forest management needs. The forest management research program was further weakened when the Canadian Forestry Service became part of the Department of the Environment, and environmental issues, especially North of 60^{0}

Latitude were stressed.

With the 1984 signing of the Canada/Manitoba Forest Renewal Agreement an additional 13 persons will be located in Winnipeg to undertake mission-oriented research and technology transfer in the Province over the next 5 years (1984-89). In addition the recently signed Memorandum of Understanding (MOU) concerning forest research should enable the CFS to once again focus more clearly on Manitoba's research and development needs.

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1.3 The Status of Current Operational Forestry Research in Manitoba

A number of forestry research projects are currently underway in Manitoba. Areas of research include: tree improvement and forest genetics, silviculture, nursery management, forest inventory, forest protection, forest environment, and forest economics. The following briefly outlines the various projects and gives the current status of each.

A. TREE IMPROVEMENT AND FOREST GENETICS

1. Provenance Trials of Softwood Species

The objective is to segregate promising seed sources for Black Spruce, Jack Pine and White Spruce to screen out well-adpated progenies with maximum productivity.

2. Phenotypes and Vegetative Propagation

Superior phenotypes of Black Spruce, Jack Pine, and White Spruce are selected from across the Province. Through vegetative propagation the improved economic traits and genetic diversity are perpetuated into the asexually regenerated progeny. Stock-scion incompatibility is to be investigated.

3. Clonal and Seedling Seed Orchards

Research for the development of improved planting stock is also done through the establishment of seed orchards. To date, clonal seed orchards have been established for White Spruce, Jack Pine and Red Pine. Seedling seed orchards have been established for White and Black Spruce. Second generation improved stock will come from these seed orchards.

4. Clone Bank

A clone bank has been established for Black and White Spruce using various seed sources. Through examination of growth variation, elite trees will be selected for scion and cone collection.

5. Plant Hormone Studies

Experimentation with various gibberellin treatments are being carried out to increase height growth and induce early cone production. Height increases of 15-20% and cone induction in 4 and 5 year seedlings has been achieved. Further trials are necessary before developing treatment prescriptions on an operational scale.

6. Seed Zonation in the Province

Provenance seed zones have been developed in the Province for White Spruce, Black Spruce and Jack Pine. Movement of reproductive stock is governed by these seed zones.

B. REGENERATION SURVEYS

1. Direct Seeding Trials by McBorkan Seeder in the Western Forest Region

The objective is to determine the success of forest renewal efforts through direct seeding. A randomized block experiment was established at 3 locations with 3 seeding intensities and 2 seeding periods. Interim recommendations based on first year results have been written as Manuscript Report #84-3.

This is a joint project between the Silviculture and Tree Improvement Sections and the Western Forest Region.

2. Regeneration Sampling

A departmental field manual currently exists for data

collation in naturally and artificially regenerated areas. The sampling technique has to be reviewed both from a statistical and operational viewpoint, field data forms updated, and the existing data to be analysed and mapped for development of silvicultural treatment prescription.

C. NURSERY MANAGEMENT

1. Seedbed Density Trials at Pineland Nursery

Raw data has been collected for 3 years of growth, established on an experimental design basis. Results have been sent to NoFRC for analysis, and consequent development of recommendations for operational implementation.

2. Fertilization Regimes for Nurture of Containerized Stock

Scientific formulation of fertilizer schedules are developed and updated every year based on local trials by the Tree Improvement Section. A nursery manual is in the process of being developed.

3. Culling of Bareroot Stock

Data are being collated every year by the Tree Improvement Section for the culling of bareroot stock based on morphological attributes and size specifications prior to shipping to field planting. A nursery manual is being developed.

4. Overwintering Systems

Skeletal overwintering systems have been established by the Tree Improvement Section for container stock. These have to be further researched to develop optimum and acceptable techniques to minimize winter damage.

D. FOREST INVENTORY

1. Permanent Sample Plots

Permanent sample plots have been established (using a Basal Area Factor 2m prism) to provide growth information for the major commercial species of Manitoba. To date, 93 plots have been established in the Interlake and Pineland Forest Sections. Plots are to be remeasured after 5 and 10 years. The first remeasurement on 75 of the plots will be done in 1984.

E. FOREST PROTECTION

1. Dwarf Mistletoe

a) Volume Loss Study

Study plots to determine the rate of spread and volume losses have been established in conjunction with the University of Minnesota. Data collection for at least 2 more field seasons is necessary prior to forming any conclusions.

b) Pruning and Thinning Treatments

Sanitation pruning and thinning is being examined as a possible treatment for the management of dwarf mistletoe. This study is in the initial stages.

2. Western Gall Rust

Attempts are being made to develop rust resistant strains of Jack Pine. Seedlings and grafted scions from candidate resistant trees have been inoculated and assessed for infection. Further inoculations over the next 3 or 4 years are necessary before final conclusions on resistance can be made. This is a joint project involving the Forest Pest Management and Forest Genetics Sections.

3. Armillaria Root Rot

a) Impact Study in Young Red Pine Plantations

The impact on growth and survival by Armillaria mellea is being assessed on planted Red Pine in the Belair Provincial Forest. This study was initiated in 1983. Additional data is needed over the next 4 years.

b) Post-Thinning Impact Study

Permanent sample plots have been established in 25-35 year old Red Pine plantations to determine if A. mellea becomes a problem following thinning. This study was initited in 1983.

4. Hypoxylon Canker

The impact of forest tent caterpillar on Aspen is being examined to determine if repeated defoliation predisposes it to Hypoxylon Canker. The study was initiated in 1982. To date, there is some evidence of a greater increase of Hypoxylon in the defoliated plots.

5. Pinewood Nematode

The pinewood nematode was recently found in Belair Provincial Forest. Research is currently underway in conjunction with the University of Minnesota to determine if this organism is a primary pathogen.

6. Dutch Elm Disease

a) Biological Control of Dutch Elm Disease

Experimentation with two possible cures for Dutch Elm Disease (Pseudomonas syringae and Trichoderma viride) was conducted over a 3 year period. Preliminary results infer a lack of success with both products.

7. Spruce Budworm

The existing egg mass sampling system (Morris, 1955) developed for Balsam Fir is being adapted to predict defoliation of White Spruce. Data collection is required for 3 or 4 more seasons.

8. Jack Pine Budworm

In 1982 a joint CFS-MNR project was initiated to develop an egg mass sampling system to predict defoliation. Egg mass counts will be correlated with the following season's defoliation over the next 3 to 4 years.

F. FOREST ENVIRONMENT

1. Effluent Effects from Spruce Point Mine on Vegetation and Soils of a Forest Discharge Site at Reed Lake

A study of mining effluent migration through vegetation and soil surrounding a discharge site.

The information was released in a report and was presented to the Clean Environment Commission Hearings to assist in the enforcement of an existing C.E.C. control order on the HBM&S mine; the study is currently ongoing.

2. Wood Preservative Industry

A study of soil contamination from toxic materials used in the wood preservative treatment process of Roblin Forest Products Ltd. The information is being finalized in report form and has been used to initiate actions to contain the loss and migration of contaminants on the site.

3. The Long-Range Transport of Air Pollutants

The Environmental Management Division is currently mapping the terrestrial sensitivity of Manitoba for the potential effect of LRTAP or Acid Rain in co-operation with the other provinces of Western Canada as well as the Northwest Territories. The Division represents Western Canada on the Terrestrial Effects Sub-Group of the Research and Monitoring Co-ordinating Committee for LRTAP in Canada. Terrestrial Sensitivity Mapping includes the mapping of soils to determine forest areas of potential sensitivity to acid rain. The Terrestrial Section also maintains a snow monitoring program to determine acid deposition throughout the Province.

4. Herbicide Effects to Forest Ecosystems

The Environmental Management Division is currently initiating programs of environmental research and monitoring to evaluate herbicide applications in forest management of the Province. Activities include Velpar field trials to take place in late May in The Pas and the Agassiz Forest as well as Roundup treatments to be used by Abitibi during mid to late summer, 1984.

5. Monitoring of Forest Change

In co-operation with INCO, a forest monitoring capability in the Thompson area is currently being developed using satellite imagery. A Landsat map showing vegetation change between 1973 and 1978 has been developed and used to detect forest damage from air pollutants emitted from the INCO smelter. Plans to extend the mapping to include 1983 imagery in Thompson and to produce a similar series of maps for Flin Flon have been presented to CMJFRC.

G. FOREST ECONOMICS

1. Fire Incidence/Weather Conditions

Objective: To determine the relationship between a variety of weather codes and indexes, and the probability of a fire start. Results will become the basis of further refinements to the MNR Fire Alert System currently under development.

Approach: Obtain daily weather codes, etc. for each MNR weather station. Identify weather station area (W.S.A.). Assign 1984 fires to each W.S.A. Run statistical correlations.

Status: Acquiring daily weather data and storing on I.B.M.P.C.

2. The Economics of Agro/Silvi-Cultural Land Use Conflicts

Objective: To develop a benefit-cost framework to resolve the economic aspects of land allocation conflicts between agriculture and forestry. The infusion of other resource sectors is anticipated in the future.

Approach: Interdepartmental committee of economists to undertake the study. Initially will depend upon a review of existing procedures and a review of the literature. Ultimately will require the construction of an econometric model to facilitate the analysis.

Status: Will be investigated depending on establishment of program priorities.

3. Fire Damage Appraisal

Objective: To develop a procedure to establish the value of losses attributable to forest fires. The value of losses plus the cost of suppression then becomes the basis for measuring the cost-effectiveness of Manitoba's fire management program.

Approach: Literature research coupled with soliciting comments from outside researchers.

Status: Stalled for lack of response.

4. Measuring Economic Benefits in Forestry.

Objective: To develop a procedure for best measuring the benefits associated with forest management. At present two approaches compete with each other. Each would result in significantly different benefit-cost ratios.

Approach: Literature research coupled with soliciting comments from outside researchers.

Status: Some research reviewed but a more formal approach is required.

PART 1

FIVE YEAR RESEARCH AND DEVELOPMENT NEEDS

APPROVED UNDER THE CANADA/MANITOBA FOREST RENEWAL AGREEMENT

2.0 RECOMMENDATIONS AND PRIORITIES

From the programs originally submitted for funding under the Canada/Manitoba Forest Renewal Agreement, inter and intra-priorization of projects within and between the program areas was undertaken through a series of meetings of the Joint Forest Research Committee comprising of representatives from the Manitoba Forestry Branch and the Northern Forest Research Centre of the Canadian Forestry Service. Finalization of the five year research plan was effected at the meeting of the joint committee on July 3, 1984. Subsequent to a tele-conference discussion by the Provincial and Federal Chairmen, ten program areas have been priorized to the allowable funding level as detailed in Table 1. The figures represent five year totals.

The individual projects within the ten program areas that have been proposed are enlisted in Table 2. Some of these are ongoing and those that have been selected for funding are indicated in the last column of the table (F). The remaining ongoing programs are detailed in Part II of this report.

3.0 FORMAT OF PROGRAM PRESENTATION

Each program area is preceded by an executive summary enlisting the project numbers and titles, annual funding levels and required staffing.

The executive summary is followed by detailed project descriptions under four sub-headings of objective, problem/need, approach and resources for each project.

4.0 RESEARCH PROGRAM AREAS

Each program area has been assigned an experiment number from CM-1 (regeneration) to CM-10 (forest environment) as shown below. The projects under each program area are further suffixed as explained in Section 2 so that ease of reference can be made. Individual projects within the program areas have been numbered in sequence of priority in which they were proposed. Of these, the experiment numbers of selected projects for funding are given within parentheses for the ten program areas as below. Hence the project numbers are non-concurrent.

CM-1 Regeneration (Three projects, CM-1.1, 1.6 and 1.7)

CM-2 Forest Nurseries (Two projects, CM-2.2 and 2.7)

CM-3 Site Classification (One project, CM-3.1)

CM-4 Forest Inventory (One project, CM-4.1)

CM-5 Yield of Managed Stands (Five projects, CM-5.1 to CM-5.5)

CM-6 Fire Management (Three projects, CM-6.1, 6.2 and 6.6)

CM-7 Forest Economics (Six projects, CM-7.1 to CM-7.6)

CM-8 Tree Improvement (Two projects, CM-8.3 and CM-8.4)

CM-9 Insect and Disease (Eight projects, CM-9.1 to CM-9.8)

CM-10 Forest Environment (One project, CM-10.1)

5.0 REGENERATION (CM-1) EXECUTIVE SUMMARY

Of the ten projects submitted for funding considerations (Table 2), 3 have been selected for five year funding as follows.

CM-1.1	Regional Reforestation Technical Committee Technology Transfer	10.0
CM-1.6	Hare Damage Risk Assessment	120.0
CM-1.7	Guidelines for the Management of White spruce	225.8
	Total	355.7

5.1 Project No. CM-1.1 Technology Transfer

Objective: To provide ongoing regional technology transfer and liaison in silviculture by means of a technical committee.

Problem/Need: Government agencies involved in silviculture across the region can benefit by an opportunity to meet with their counterparts from other provinces or territories and exchange information and ideas concerning common silvicultural problems. Such interchange also generates R & D leads which can be transmitted to regional researchers for further action.

Approach: The Regional Reforestation Technical Committee was established in 1979 with representation from government silviculturists in Alberta, Saskatchewan, Manitoba, the Northwest Territories, and the Canadian Forestry Service, the latter providing the chairman. Each year a different province hosts the meeting, providing members with a chance to see a broad range of silvicultural conditions and practices. The

committee has primarily a technology transfer function, and should continue in this role, with funding for Manitoba coming from the Agreement when travelling outside the Province.

Resources: Travel expenses - $10,000 (MNR-CFS)

5.2 Project No. CM-1.6 Hare Damage Risk Assessment

Objective: To obtain an assessment of hare damage susceptibility of young stands (planted and natural) in Manitoba.

Problem/Need: There is considerable evidence from general observations and plot assessments that hares can pose a serious risk to new forests in Manitoba, especially at peak populations, which occur at approximately 10 year intervals. Degree of hare damage varies from one location to another and R & D is required to determine if there are measurable factors which can be used to assign risk to specific areas, thus enabling managers to reduce hare damage, either through control measures in high risk areas or by avoidance of such areas in planting programs if control measures are not available.

Approach: A contract will be developed to obtain an assesssment of hare damage risk in various stand types and stand type matrixes.

Resources: Contract (2 years) - $120,000 (CFS).

5.3 Project No. CM-1.7 Guidelines for the Management of White Spruce

Objective: To develop guidelines for conversion of Aspen and Aspen/Spruce stands to White Spruce, and to increase success of White Spruce regeneration following current and future White Spruce harvesting.

Problem/Need: There are large areas of highly productive forest land which would be suitable for White Spruce production but are dominated by Aspen, either as a result of past harvesting or fire. The amount of such land is steadily increasing because of ineffective conversion techniques and current harvesting and site management practices. Such techniques and practices require review and modification if these productive sites are to be successfully regenerated to White Spruce.

Approach: The CFS has done considerable work on Aspen and White Spruce in Manitoba in the past such as that of Haig and Jarvis and the MS-238 project at Pine Falls. This work should be remeasured, analysed and reported through a Silvicultural Specialist hired under the Agreement.

Resources: One 5-year term P/Y (CFS) and $225,700 (Salary and O & M).

6.0 FOREST NURSERIES (CM-2) EXECUTIVE SUMMARY

Two projects have been selected for the five year allowable funding level.

CM-2.2	Technology Transfer	10.0
CM-2.7	Development of Large High Quality Stock	210.0
	Total	220.0

6.1 Project No. CM-2.2 Technology Transfer

Objective: To provide technology transfer in nursery and greenhouse management in order to ensure state-of-the-art practices in stock production.

Problem/Need: Nursery and greenhouse technology changes rapidly and the impact of such change is particularly significant where production must be increased to meet the demands of an expanding reforestation program.

Approach: CFS staff at NoFRC will sponsor the Regional Nurseryman's meeting in 1984 as part of an ongoing commitment to technology transfer. In addition, a workshop on nursery practices will be undertaken in 1985.

Resources: Travel expenses - $10,000 (MNR-CFS)

6.2 Project No. CM-2.7 Development of Large High Quality Stock

Objective: To develop large high quality stock for use in reforestation of difficult sites, especially highly productive mixedwoods.

Problem/Need: Many of the most productive sites in Manitoba are difficult to reforest because of exceptional competition from brush, grass and herbs, as well as unwanted tree species. Such competition can be reduced to some extent by site preparation and use of herbicides, but it appears that a prescription for larger than average, more competitive planting stock, could be a major benefit in getting these sites back into production with minimum loss of time. Such costs will require special production facilities and some research.

Approach: Manitoba should develop stock standards for difficult productive sites. The CFS staff at NoFRC will provide advice as requested and will consider assistance in field performance tests once outplanting is achieved. A specialized greenhouse with facilities for studies of accelerated growth in stock production, including the use of extended photoperiod, high intensity lights, hormones and mycorrhiza will be necessary. Current and ongoing research at NoFRC into flower induction and growth acceleration is relevant to this priority, and study species for 1985 can be chosen to reflect Manitoba's needs.

Resources: Contract (4 years) - $210,000 (MNR)

7.0 FOREST MANAGEMENT SITE CLASSIFICATION SYSTEM

(CM-3) EXECUTIVE SUMMARY

One project has been identified as below with the allocated funding for five years.

CM-3.1 Forest Site Classification System

1 Federal Person Year	225.7
Other Expenditures	415.0
Total	640.7

7.1 Project No. CM-3.1 Forest Management Site Classification

Objective: To develop and implement a forest site classification for Manitoba which adequately reflects significant differences in site productivity and for which meaningful silviculture and other forest management prescriptions can be developed.

Problem/Need: Forest Inventory - growth and yield. The Manitoba Inventory Section is presently using a relatively simple site classification system based on a small number of site attributes: 9 soil texture, 3 soil depth, 3 topographic position, and 6 moisture regime (including the use of plant indicators) classes. Productivity is presently related to volume yields and, to date, the use of Site Index has not been incorporated into the system. This system of site identification and productivity is based to a large extent on earlier research (1950's) undertaken in the Province by Rowe, Cayford, and Jameson util-

izing the site classification system devised by Hills. It is recognized that the present classification has proven useful in the past but a higher degree of sophistication is required now in order to meet the needs of intensive forest management. It should be pointed out here that J. Ritchie prepared a report which relates specifically to productivity on various sites in the Sandilands Forest Reserve which has not been utilized to date.

Silviculture - A number of soil and forest management site classifications systems have been devised over the years in Manitoba and they include work undertaken by J.S. Rowe, D. Mueller-Dumbois, the Manitoba Soil Surveys, and the Canadian Land Inventory (CLI). The Hills classification system, as modified by Rowe, has been exclusively used by CFS to describe site on silviculture experimental areas; Mueller-Dumbois system of classification in the Sandilands Forest Reserve is being used on a limited forest management basis by the Regional Forester; silviculture interpretations of the Manitoba Soil Surveys carried out in the Southeastern and Lac du Bonnet area have been provided by Cayford and Jameson, and Zoltai respectively. The CLI classification and maps contain some information relating to both productivity and silviculture prescriptions but are not used by

Regional Foresters to any extent. It is recognized that if intensive forest management practices are to be adopted a comprehensive, province-wide site classification system is essential.

Approach: To achieve the stated objective it will be essential for a qualified professional to develop the framework for a forest mangement site classification system to which meaningful interpretations of productivity, silviculture prescriptions, and other forest management concerns can be applied. This will involve a review of provincial needs, an analysis of previous soil and site classification systems within the Province, and a review of related site classifications in place throughout Canada. Field work would be undertaken utilizing contract funds. Some general comments, which arose from Federal-Provincial discussions, are presented here. It has been suggested that the number of site types relating to productivity be limited (maximum of 9) but it is doubtful that these broad generalizations will prove useful to silviculturalists. It's the old question of "lumpers" vs. "splitters" and the level of detail which is required to undertake intensive

forest management. Another qualifier is that the sites should be recognizable on aerial photographs - this is probably possible when delineating zones and sub-zones but less likely as the "site-unit" becomes smaller. It is also desirable from the inventory point-of-view that site productivity classes should be identical across the forest zone. There is also the need to have a direct relationship between the site classification and Site Index classes of the Canadian Forest Resource Data System (CFRDS). It goes without saying that there are just as many needs and constraints on the silviculture side of this issue especially when one considers the choice between mapped units vs. identification keys. The opinion has been expressed that it would be highly desirable to have some commonality amongst the forest site classifications used in the three prairie provinces.

Resources: This is a new, long-term (20+ years) CFS-MNR co-operative project under the Canada/Manitoba Forest Renewal Agreement. In order to achieve continuity it will be necessary for the MNR or NoFRC to establish at least one indeterminate position. The person in this position would devise the forest site classification system (in consort with the experts and the users) and co-ordinate and supervise the field work required. The field portion of the program will be carried out

under contract. In keeping with the dimensions of this undertaking it should be stressed that considerable input will be required at a later stage by research and operational mensurationists and silviculturalists in order to assign meaningful site productivity ratings and prepare silviculture prescriptions. Contract (4 years) $415.0

8.0 FOREST INVENTORY (CM-4) EXECUTIVE SUMMARY

One project has been identified within the allowable funding level of $275.0 for five years.

CM-4.1 Yield of Natural Stands $275.0

8.1 Project No. CM-4.1 Forest Iventory - Yield of Natural Stands

Objective: To predict yields for all natural, untreated stands classified by Manitoba's Forest Inventory System for future planning periods.

Problem/Need: Information concerning estimates of future wood volumes is required in order to provide improved means of planning opportunities for forest industrial development in the Province. This shortcoming was identified in Manitoba's Forest Management Plan, 1981-2000. Only the most general information of minimal use is presently available for evaluation purposes. Natural stands make up the major portion of Manitoba's forest.

Approach: Develop total crop volume over mean height relationships for each of Manitoba's major cover types and develop procedures for adjusting growth trends in understocked stands using available forest inventory data.

Identify available permanent sample plot locations for information available.

Identify species or working groups where permanent sample plots are rare or non-existent within Manitoba's forest zone.

Determine specific information required to be measured on each permanent plot following Provincial and National needs.

Establish a minimum of 25 permanent plots per year commencing in 1985 with initial plots located in the species, age class and area of most importance.

Remeasurement to be at five year periods.

Examine options available for a stand and tree evaluation and modelling system designed to predict yield through computer techniques.

Resources: Development of volume over height relationships to be carried out by Manitoba Forest Inventory Section with CFS personnel providing guidance on procedures to be followed. Manitoba Forest Inventory field crews to establish permanent plots during regular field duties commencing 1985 based on guideline requirements for

permanent plot establishment provided by CFS.

CFS and Manitoba Forest Inventory personnel to examine the applicability of computer based modelling systems for growth and yield in Manitoba and if suitable system is available, obtain and operationally install on the Forest Inventory Hewlett Packard 1000 computer system.

Outside contracts may be applicable to assist the foregoing resource requirements OVER THE FIVE YEAR PERIOD.

No. of Federal PYs	PY Cost	Allocation	Total Budget
0	0	275.0	275.0

9.0 YIELDS OF MANAGED STANDS (CM-5) EXECUTIVE SUMMARY

Five projects have been identified as below within the 5 year allocated budget of $268.0

CM-5.1	Technology Transfer	8.0
CM-5.2	Releasing White Spruce From Aspen - Biological Aspects	50.0
CM-5.3	Releasing White Spruce From Aspen - Inventory Aspects	70.0
CM-5.4	Releasing White Spruce From Aspen - Economic Aspects	80.0
CM-5.5	Stand Tending Demonstrations	60.0
	Total	268.0

9.1 Project No. CM-5.1 Technology Transfer

Objective: Organize a workshop on spacing, stocking and thinning for the two major conifer species, Jack Pine and White Spruce in late 1984 or early 1985.

Problem/Need: With more intensive forest management, planting, spacing and commercial thinning are being used at an ever increasing scale especially in the management of the two most valuable conifer species, White Spruce and Jack Pine. A number of related studies initiated in the past 25 years or even before, are continuously monitored by the Northern Forest Research Centre. Although results have been published as they became available, some of these may have never reached the field forester, or if they did, may not have been in a form suitable for their direct use. Such published results may also apear diverse, fragmented or even conflicting.

Approach: A workshop together with a field trip to suitable demonstration areas is to be organized to clarify and synthesize relevant available information. Such a workshop will also provide an opportunity for the attending managers and field foresters to share their practical experience, insights and concerns.

Resources: The workshop will be organized by the CFS in co-operation with the Manitoba Natural Resources at a suitable location in Manitoba.

Travel exenses - $8,000.

9.2 Project No. CM-5.2 Releasing White Spruce from Aspen - Biological Aspects

Objective: To synthesize available information from research studies in the region, as well as published results on releasing White Spruce from Trembling Aspen competition.

Problem/Need: The two principal tree species in the Boreal Mixedwood are White Spruce and Trembling Aspen. Due to its rapid early growth, Trembling Aspen overtops the White Spruce and hinders its development. To promote the growth of the much more valuable conifer, individual White Spruce trees can be released by removing the competing Aspen. Although a costly treatment, the benefit is a merchantable White Spruce crop several decades earlier than without.

Approach: Several studies have been initiated in the 1950's and 1960's by the CFS and some by the Manitoba Natural Resources to determine White Spruce growth after release. Some results have been published. All this and related information available in the literature should be reviewed, synthesized and written up in a form ready for use by the field forester.

Resources: This synthesis and reporting should be done through outside contract funded from the Agreement to approximately $50,000.

New under Agreement (CFS) contract.

9.3 Project No. CM-5.3 Releasing White Spruce from Aspen - Inventory Aspects

Objective: To identify mixed stands of White Spruce - Trembling Aspen which would be suitable to release White Spruce from Trembling Aspen competition.

Problem/Need: The two principal tree species in the Boreal Mixedwood are White Spruce and Trembling Aspen. Because of its rapid early growth, Aspen overtops the Spruce and hinders its development. To promote the growth of the much more valuable conifer, individual White Spruce trees can be released by removing the competing Aspen. Although a costly treatment, the benefit is a merchantable White Spruce crop several decades earlier than without treatment. To conduct such treatment, suitable stands have to be identified.

Approach: Existing inventory should provide initial information. Detailed information may be obtained from photo interpretation of existing photographs, or on certain areas, from new photographs that are yet to be taken. Stand selection criteria include: large, accessible mixed stands near mills, well stocked with White Spruce and growing on good sites.

Resources: Contract - $70,000.

9.4 Project No. CM-5.4 Releasing White Spruce from Aspen Economic Aspects

Objective: Assess economic implications of mechanical release of trees in young stands.

Problem/Need: Vigor and early growth of coniferous regeneration and young stands depends to a large degree, especially on the most productive sites, on the control of competing broadleaf forbes, shrubs and tree species. In the last decade, various herbicides have been used effectively to control such competing vegetation. However, increasing recent concerns about environmental pollution has reduced the use of these herbicides and further restriction, or even bans, are likely.

The alternative is traditional mechanical release or cleaning in young stands, or individual stem injection with herbicides in polesize or older stands. Such an approach is much more costly, thus increases the need for thorough analysis of management alternatives, benefits and costs.

Approach: Obtain relevant production cost information from operational release work in the region and conduct benefit-cost analysis that can provide guidelines for similar operations in the future.

Resources: Contract - $80,000.

9.5 Project No. CM-5.5 Stand Tending Demonstrations

Objective: Develop demonstration areas on stand tending.

Problem/Need: Although our primary means of communicating research results as well as information arising from experience is th.ough the printed media, discussions and on-site demonstrations can also play an important role. "Show and Tell" seminars on stand tending can be particularly useful, as the stand itself remains a living record of past treatment and response.

Approach: Previous experimental areas and operational trials can be used for demonstrations especially those that are easily accessible.

Opportunities for such demonstration areas are available for Jack Pine and Black Spruce fertilization, White Spruce spacing, conversion of Aspen to White Spruce, releasing White Spruce from Aspen and regeneration techniques for Black Spruce, etc.

The first task is the selection of suitable areas, development of trails, viewpoints, etc.; then stand history has to be documented and current conditions described in a brief summary.

Resources: Contract - $60,000.

10.0 FIRE MANAGEMENT (CM-6) EXECUTIVE SUMMARY

Three projects have been selected from the original submission of six as listed in Table 2 within the allowable five year funding level of $310.7.

CM-6.1	Information Transfer	45.0
CM-6.2	Decision-aid Models	180.7
CM-6.6	Fuel Type Mapping	85.0
	Total	310.7

10.1 Project No. CM-6.1 Information Transfer

Objective: To provide information transfer in fire research - management to the Province of Manitoba to ensure state-of-the-art practices are utilized in the conduct of fire business.

Problem/Need: Fire management agencies continue to evolve toward increased sophistication and fire-fighting capability. Fire management strategies and technologies are changing rapidly, having the potential for considerable impact on cost-effective fire management. Information transfer is often called and may include: technology transfer, knowledge utilization, diffusion of innovation, application and extension. Technology transfer and application are the implementation and use of the results of research and development efforts. Extension is much broader and involves user assistance in implementing professional knowledge, state-of-the art technology

and information. The all encompassing broad definition of information transfer is preferred to ensure that wide-ranging needs of the Province are adequately addressed.

Approach: The changes anticipated as a result of new approaches and technologies is best facilitated through effective communication, co-operation and understanding between researchers and fire managers. Some ways to achieve this include: a) improved summarization, review and interpretation of fire research/management activities, b) preparation of guidelines, handbooks and training materials, c) convening of workshops and seminars on fire research programs and fire management practices, d) utilization of existing and development of new co-ordination mechanism, e) development of demonstration programs and areas that utilize advanced fire/fuel management techniques, f) utilization of existing current research information systems, g) direct communication and personal contact between users and research personnel.

10.2 Project No. CM-6.2 Decision-aid Models

Objective: To research and develop relevant decision-aid models and to introduce appropriate new information summarizing technologies using management science and computing systems designed to assist fire management

agencies in optimizing the allocation and use of available resources during demanding or multiple fire occurrence situations.

Problem/Need: Fire management agencies must deal with severe budget restrictions and rapidly increasing labour costs. The protection role of regional fire management agencies is complicated by the extreme variability of the occurrence and behaviour of wildland fires. There is an urgent need for researching and developing efficient ways to assess the state of the forest fire environment and anticipated fire control loads along with improved daily planning tools. Management science concepts and computer technologies can be applied to daily decision-making processes to provide an improved response to individual fire situations.

Approach: Terms of reference and a reasonable time-frame in which to conduct a problem analysis must be established in preliminary discussions. The initial phase should be concerned with gathering the resource and data bases upon which a comprehensive program can be developed. Data base management hardware and software in the form of mini-computing systems and programs must be identified. Systems analysis, computing and other related support functions should be realized in the first 2-3 years of the study.

Data base management systems for weather, fire, fuel and lightning must be designed or modified from existing systems along with the necessary interface software.

Resources: For Project Nos. CM-6.1 and CM-6.2

One 5-year term P/Y (CFS) 225.7

(Salaries and O & M)

10.3 Project No. CM-6.6 Fuel Type Mapping

Objective: To prepare a fuel type map for the Province of Manitoba based on available forest inventory, cover-type and other ecological land classification information, that will best account for the most important differences in fire behaviour.

Problem/Need: Fuel type is defined as "an identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of spread or difficulty of control under specified burning conditions". The fuel factor is an integral part of the fire environment along with weather and topography. These three components manifest themselves as fire behaviour. To better understand and predict fire behaviour, particularly rate-of-spread, intensity and crowning potential, a better fuel information base is required. This information will assist the fire management agency in control planning for allocating

protection resources, assigning priorities to fires as they are reported, judge the required size of the attack force, and predict future behaviour of going fires.

Approach: The cost of obtaining quantitative fuel information over large areas is prohibitive and, at this time, difficult to relate to fire behaviour in absolute terms. What is required is a simple but adequate fuel-type classification, sacrificing detail for utility. The number of fuel-types, based on existing inventory or cover-type data, should not number more than ten, at least initially, acknowledging that considerable variation exists in each. The fuel-type classification should be based on the local forest variables that experienced judgment suggests are responsible for major differences in fire behaviour. Possible bases for classification are one or more of species composition, age differences, stand density and structure, slash types and special stand history. Information available from the Manitoba Centre for Remote Sensing should be reviewed to determine its usefulmess in preparing a provincial fuel-type mapping scheme.

Resources: R & D Contract - $85,000. (MNR)

11.0 FOREST ECONOMICS (CM-7) EXECUTIVE SUMMARY

Six projects have been identified below as part of the 5-year budget allocation of $542.7.

		P/Y	Other	Total
CM-7.1	Northern Employment Development	54.2	150.0	204.2
CM-7.2	Economics of Intensive Forest Management	40.6	40.0	80.6
CM-7.3	Damage Appraisal	18.1	12.0	30.1
CM-7.4	Incentives and Regulations	9.0	35.0	44.0
CM-7.5	Industrial Structure	90.3	50.0	140.3
CM-7.6	Harvest Scheduling	13.5	30.0	43.5
	Total	225.7	317.0	542.7

11.1 Project No. CM-7.2 Northern Employment Development

Objective: To identify meaningful employment opportunities which can be provided by the forestry sector for residents of northern Manitoba.

Problem/Need: Unemployment is a critical issue in many of the Province's northern communities. As there are a limited number of readily identifiable employment opportunities, the region's forest base has often become the basis for special employment programs. To ensure meaningful and lasting benefits from these projects, it is necessary to ensure that such programs are consistent with local needs and skills and that

they ensure the future viability of the forest resources. Research is required in the following areas in order to address this issue:

a) assessments of the local demand for wood products in the northern communities, with the ability of the community to service these demands;

b) assessments of a community's competitive position regarding its integration into region's wood supply market;

c) determine the relative benefits and costs of providing employment opportunities through the forest management programs as compared to the commercial options available.

Approach: Case studies of 3-5 communities would be required. A less intensive analysis of a comparable number of communities would be prepared to test the validity of any general conclusions reached in the first stage of the study. Regional models, incorporating the long-term investment intentions of the industry would be the basis for determining a specific community's position within the regional wood supply market. The advantages and disadvantages of these approaches as compared to contracting forest management projects through these special employment programs would then be determined via benefit/cost analysis. The community case studies would be prepared by con-

sultants, including university researchers. CFS and Manitoba representatives would be required to finalize the benefit/cost analysis.

Resources: Contract - $150,000.

1.20 CFS P/Y with associated O & M; $54,200.

11.2 Project No. CM-7.2 Economics of Intensive Forest Management

Objective: To develop and implement an economic assessment framework for the purpose of providing guidelines to forest managements to ensure the most cost effective use of funds in intensive forest management.

Problem/Need: In addition to normal operating budgets, the government of Manitoba in conjunction with the government of Canada has devoted $27.1 million by funding the Canada/Manitoba Forest Renewal Agreement over the period 1984-89. Forty-nine percent of these funds will be devoted to intensive forest management projects including: site preparation, seeding, planting, fertilization, conifer release, drainage, juvenile spacing, and pre-commercial thinning. To ensure effective and efficient use of both ongoing forest management programs of the Manitoba Natural Resources, a procedure for evaluating prospective forestry investments in economic terms must be developed and implemented. Without such an objective evaluation system in place, decision making will con-

tinue to be made on the basis of best guesses and the probability of misallocation of resources is high.

Approach: The theories, models and implements for economic evaluation of forestry investments are well developed. The fundamental information requirements for an economic assessment framework include: a) yield responses to treatments; b) resource values (present and future); c) treatment costs; and d) time preference rates for money (interest rates). The approach will be to:

a) become familiarized with existing frameworks and systems;

b) modify to suit Manitoba circumstances;

c) review data requirements for framework;

d) assess existing sources of data;

e) collect additional required data;

f) implement framework;

g) assess the performance and adjust as improved data and/or systems become available.

The framework would be designed to perform sensitivity analysis to illustrate the effect of differences in the assumed input values.

Resources: Contract - $40,000.

0.90 CFS P/Y with associated O & M $40,000.

11.3 Project No. CM-7.3 Damage Appraisal

Objective: To implement a damage appraisal and valuation system for the purpose of assessing values at risk and post fire economic impact.

Problem/Need: Management strategies relating to wildfire management efforts have traditionally been framed in terms of bio-physical objectives. These strategies disregard the fact that all fires do not necessarily have a negative economic impact. Depending on the characteristics of the resource in a particular area, economic impact of a fire may be nil. In fact, some fires may incur an increase in the economic value of the resource. A damage appraisal and valuation system based on economic criteria would provide better information to decision makers faced with having to address fundamental questions such as: a) What is the most appropriate fire management budget?; b) What is the proper allocation of expenditures between the various fire management functions?; and c) Which areas merit a greater fire management effort based on the economic value of the resource?

Approach: Considerable research has been devoted to the development of damage appraisal and valuation systems in Canada and particularly in the United States. The challenge for this priority will be to: a) assess the various systems; b) adopt one; c) initiate data

collection and d) implement the model for operational use.

Resources: Travel and computer expenses; $12,000.

0.4 CFS P/Y with associated O & M $18,100.

11.4 Project No. CM-7.4 Incentives and Regulations

Objective: To assess the effect of various existing and potential incentives and regulations upon the forest industry within Manitoba.

Problem/Need: Incentives and regulations are employed by forest managers to influence the behaviour of resource users and/or partially finance forest management programs which directly affect the resource users. It is an established rule in economics that those affected by incentives and regulations will react in such a way as to make the best of the situation. Sometimes the reaction is in an unexpected direction which partially undermines the original intent of the incentive or regulation. As there are a variety of incentives or regulations which could be designed to further a specific objective, it is desirable to examine each alternative in order to identify the most cost efficient and beneficial mechanism in the Manitoba context. Such a study would assist forest managers in avoiding to recreate undesirable burdens upon resource users. Specific areas of concern are as follows:

a) financing incremental forest management programs;

b) financing improved fire management programs, and

c) implementing closer utilization standards.

Approach: This study would rely upon work already prepared for other jurisdictions. Should an appropriate model be identified that can be used for this Province's forest industry, then simulation analysis would also be used.

Resources: Contract - $35,000.

0.2 CFS P/Y with associated O & M $9,000.

11.5 Project No. CM-7.5 Industrial Structure

Objective: To determine the current size, structure and economic impact of the primary wood using industries in Manitoba.

Problem/Need: Although the efforts of Statistics Canada in the provision of forest industry data in Manitoba are valuable, certain deficiencies are identifiable including:

a) detailed information on certain items important to policy formation and further analysis is not provided;

b) information is not provided at the sub-regional level, (i.e., Forests or Forest Sections);

c) statistics are derived from self-response mail-in questionnaires;

d) some undercoverage occurs because all mills are not considered in the summaries;

e) of cumbersome industrial categorizations.

To respond to these deficiencies, there is a need to periodically (i.e., every 5 years) update the forest industry data base with detailed information to satisfy the full component of users of forest industry statistics.

Approach: CFS staff at NoFRC have been actively involved in the collection, analysis, and dissemination of detailed forest industry information in Manitoba over the last 12 years. To continue this research, the industry in Manitoba should be re-evaluated in 1985. In order to utilize the experience and knowledge gained during past assessments, the research priority should remain the responsibility of the NoFRC. The proposed approach is to employ a combined census-survey type assessment to obtain the best information available while minimizing costs of collection, analysis and dissemination.

Resources: Data acquisition, processing and dissemination; $50,000.

2.0 CFS P/Y with associated O & M $90,300.

11.6 Project No. CM-7.6 Harvest Scheduling

Objective: To provide technology transfer in the application of recently developed procedures and techniques re-

garding decision making aids designed to improve forest and timber management.

Problem/Need: As the demands on the forest resource in Manitoba increase through time, resource allocation decision making will inherently become more complex. A number of quantitative assessment procedures are available which would significantly improve the analytical reliability and capability of the MNR, thereby instilling a higher level of confidence in the decision making.

Approach: The University of Alberta, Forest Science Department has an ongoing program devoted to the assessment and practical application of harvest scheduling models. U of A personnel have developed considerable expertise in this area, and would be in a good position to evaluate the Manitoba situation in terms of computing capability, inventory information, growth and yield information, and forest management objectives. The ultimate objective would be to recommend the most appropriate operationalization of this technology.

Resources: Travel and seminar costs (including computer assistance;
$30,000.

0.3 CFS P/Y with associated O & M $13,500.

12.0 TREE IMPROVEMENT (CM-9) EXECUTIVE SUMMARY

Two projects have been priorized as follows for a budgeted amount of $120.0.

CM-8.3	Rooted cutting systems	110.0
CM-8.4	Technology Transfer - Workshop	10.0

12.1 Project No. CM-8.3 Rooted Cutting Systems

Objective: To develop efficient and locally adapted procedures for vegetative propagation of Jack Pine, Black Spruce, and White Spruce planting stock on a commercial scale.

Problem/Need: Seed orchards now provide the only proven mechanism for production of genetically improved planting stock of Jack Pine, Black Spruce, and White Spruce. There are a number of problems associated with the seed orchard approach; the most important being cost. If planting stock can be produced by rooting stem cuttings, or by other methods of vegetative propagation, genetic improvement achieved by selection can be transferred to commercial plantations more economically. A system for genetic improvement and planting stock production based on vegetative propagation would circumvent seed orchard establishment problems, and would accelerate the genetic improvement of plantation productivity.

Approach: Previous research by others has shown that stem cuttings of conifer seedlings are easily rooted. At

Orono Nursery in Ontario, development of improvement production systems based on vegetative propagation is underway for Black and White Spruce. Research on *in vitro* production of conifer plantlets is yielding promising results at the University of Calgary. Work proposed under this priority would seek to adapt and optimize procedures for the three species of interest, for routine use in Manitoba's forest nurseries. It is most likely that this work would be procured under contract.

Resources: R & D contract (2 years @ $55,000) $110,000

12.2 Project No. CM-8.4 Technology Transfer - Workshops

Objective: To improve proficiency of tree improvement personnel in technical procedures, in order to increase the efficiency of implementing tree improvement programs.

Problem/Need: While effectiveness of tree improvement programs is dependent upon program strategies, progress in implementation with limited staff resources is strongly influenced by staff proficiency in techniques such as vegetative propagation, rearing of seedlings, plantation establishment and tending, and greenhouse management. Opportunities to recognize and correct sub-optimal techniques are not readily available, with the result that potential benefits of programs are not fully realized in every instance.

Approach: It is proposed that workshops be held once in each year for about one week, with region-wide participation of professional and technical tree improvement staff. Each workshop might deal with a single technique, and would consist mainly of discussions and practice sessions. Formal papers or proceedings would not be emphasized.

Resources: Travel expenses $10,000.

13.0 INSECT AND DISEASE (CM-9) EXECUTIVE SUMMARY

Eight projects have been identified and are summarized in Chart "A" below.

CHART "A"

Project Numbers	Project Title	Annual Cost O&M/ Contract (000's)	Total 5-Year Cost (000's)	Lead Agency
CM-9.1	Impact of Pests & Damage Appraisal			
	1.1 Volume Loss JP Budworm	3.0	15.0	CFS
	1.2 Volume Loss Spruce Budworm	1.0	5.0	CFS
	1.3 Pest Impact on Forest Renewal	8.0	40.0	MNR/CFS
	Sub-Total Project 1	12.0	60.0	
CM-9.2	Tree Mortality in Young Stands			
	2.1 Armillaria in Red Pine	2.0	10.0	MNR
	2.2 Tree Mortality/ Volume Loss, JP, BS, WS, RP	13.0	65.0	MNR/CFS
	2.3 Post Thinning in RP	2.0	10.0	
	Sub-Total Project 2	17.0	85.0	
CM-9.3	Pest Survey Methods			
	3.1 JP Egg Mass Sampling System	2.0	10.0	CFS/MNR
	3.2 Spruce Budworm Egg Mass Sampling System	1.0	5.0	CFS/MNR
	3.3 Improvement in Existing Surveys	1.0	5.0	CFS/MNR
	Sub-Total Project 3	4.0	20.0	

CM-9.4	Management of Pest Susceptible Forests			
	4.1 Pest Resistance/ Vulnerability-tree Improvement	6.0	30.0	MNR/CFS
	Sub-Total Project 4	6.0	30.0	
CM-9.5	General Pest Surveys			
	5.1 Major Forest Pests	8.0	40.0	MNR/CFS
	Sub-Total Project 5	8.0	40.0	
CM-9.6	Special Surveys			
	6.1 Intensive Surveys	5.0	25.0	CFS/MNR
	6.2 Pest Specific Intensive Surveys	4.0	20.0	
	Sub-Total Project 6	9.0	45.0	
CM-9.7	Forest Pest Control			
	7.1 Site Specific & Operational Surveys For Control	2.0	10.0	MNR/CFS
	7.2 Pest Management Activities	4.0	20.0	MNR/CFS
	Sub-Total Project 7	6.0	30.0	
CM-9.8	Diagnostic & Advisory Services			
	8.1 Disease & Insect Reference Collection	1.0	5.0	CFS
	8.2 Pest Technology Transfer	1.0	5.0	CFS
	8.3 Tech. Training of Existing Staff	1.0	5.0	CFS
	8.4 Manuals	1.0	5.0	CFS
	Sub-Total Project 8	4.0	20.0	
	GRAND TOTAL	66.0	330.0	

13.1 Project No. CM-9.1 Impact of Pests and Damage Appraisals

Objective: To develop methods for predicting short and long term impacts of pest(s) including damage appraisal on forest resource uses, values, management plans and operations. To determine how and to what extent pest damage affects forest resource users and management plans.

Problem/Need: As forest management intensifies in Manitoba, concern for insect and disease losses has increased. Forest managers are especially concerned with identifying existing problems and predicting what effects various management practices will have on potential future damage from pests. There are special needs to:

1.1 Develop and test (or apply) methodology for estimating volume losses due to mortality or growth reduction caused by the Jack Pine Budworm to be initiated in 1984. (CFS) $15.0

1.2 Develop, test and apply methodology used to measure and evaluate growth loss and mortality in selected areas with varied Spruce Budworm histories. Started in 1980 (CFS). $ 5.0

1.3 Determine the impact of pests on forest renewal (CFS/MNR) $40.0

Approach: Measure volume losses due to growth reduction caused by the Jack Pine Budworm in 10 plots established in 1983, and establish additional plots if resources are available. Continue to assess Spruce Budworm damage in impact plots established in 1981. CFS staff will analyse report on the budworms studies.

To achieve the objectives under the impact of pests on forest renewal, a qualified professional will be employed.

Resources: $60.0 as indicated in Chart "A".

13.2 Project No. CM-9.2 Tree Mortality in Young Stands

Objective: To develop methodology to estimate tree mortality in young regeneration or plantations.

Problem/Need: 2.1 Determine impact of armillaria root rot in young red pine plantations. 1983-88 (MNR) $10.0

2.2 Develop methodology to estimate tree mortality/volume loss in young Jack Pine, Black Spruce, White Spruce and Red Pine plantations in Manitoba. Ongoing study, started 1982 (CFS/MNR) $65.0

2.3 Develop methodology to estimate post-thinning impact in 25-35 year old Red Pine plantations. Started 1983 (MNR) $10.0

Approach: Permanent plots to study the impact of Armillaria on Red Pine were established in 5 to 8 year old plantations in 1983. Tree measurements and conditions to be assessed annually. The next study (2.2) is to determine tree survival from establishment to age 35; to relate survival to site condition and to prepare a set of survival curves for each site class. A study for monitoring survival of young Jack Pine was initiated by CFS in 1981-82 and 800 Jack Pine plots established.

For the post thinning impact study, MNR staff established permanent plots in thinned 25-35 year old

Red Pine plantations. The occurrence of Armillaria in stumps and tree condition to be recorded annually and growth measurements bi-annually.

Resources: $85.0 as indicated in Chart "A".

13.3 Project No. CM-9.3 Development of Pests Survey Methods

Objective: To improve or develop FIDS methods to assess population and infestation levels.

Problem/Need: Reliable sampling methods and accurate surveys are needed to determine insect population changes and infestation levels under Manitoba forests and climatic conditions; and to forecast outbreaks, defoliation or damage. Currently, sampling techniques in use are for different host trees and for other provinces or states. There is a need for:

3.1 Development of a Jack Pine egg mass sampling system to predict defoliation levels (CFS/MNR) $10.0

3.2 Development of a Spruce Budworm egg mass sampling system for the prediction of defoliation on White Spruce. (CFS/MNR) $5.0

3.3 Improvement of existing detection methods and sampling procedures for operation surveys, e.g. the use of remote sensing to detect infestations and resulting damage. (CFS/MNR) $5.0

Approach: A co-operative study (CFS/MNR) was initiated in 1983 to develop an egg mass sampling system for the Jack Pine budworm. Ten permanent plots were estab-

lished in a current outbreak area. This infestation will be used to conduct impact study 1.1 also. MNR staff established plots in 1982 to develop a sampling system for prediction of Spruce Budworm defoliation on White Spruce. Egg mass counts, larval collections, defoliation assessments have been completed to 1983 and will be continued to 1986. Literature search and experiments will continue to improve pests detection methods and sampling procedures especially by use of pheromones and remote sensing.

Resources: $20.0 as indicated in Chart "A".

13.4 Project No. CM-9.4 Management of Pest-Susceptible Forests

Objective: To manage pest-susceptible forests and pest populations to limit forest damage to tolerable levels by use of silvicultural, chemical and biological techniques.

Problem/Need: 4.1 Evaluate tree improvement opportunities for reducing susceptibility/vulnerability. Development of rust resistant Jack Pine (CFS/MNR) Study 1982 - continuous. $30.0

Approach: CFS/MNR staff selected candidate rust resistant Jack Pine in 1982-83 and seeds from both resistant and susceptible trees germinated. Grafting, collections, inoculations of seedlings and assessment will be continued to 1987.

The host-parasite interactions of western gall rust with hard pines is a laboratory study under contract to 1986.

Resources: $30.0 as indicated in Chart "A".

13.5 Project No. CM-9.5 General Pest Surveys

Objective: To conduct general surveys of forest pest conditions and their damage.

Problem/Need: There is a provincial and national need for:

5.1 Detection, identification, monitoring, mapping and evaluation of infestations of major forest pests, namely:

- Dwarf mistletoes
- Jack pine budworm
- Spruce budworm
- Forest tent caterpillar
- Other sporadic pests that may appear suddenly.

(CFS/MNR) $40.0.

Approach: This is an ongoing project funded under the existing R & D program that provides a very important contribution to the pest management system. Major pest conditions are surveyed and mapped annually and several reports including pest forecast are prepared. These surveys are conducted aerially by aircraft and on the ground for identification and evaluation.

Resources: $40.0 as indicated in Chart "A".

13.6 Project No. CM-9.6 Special Surveys

Objective: To conduct special surveys and studies of particular pests or of designated areas.

Problem/Need: 6.1 Conduct intensive surveys where forest managers require information in addition to that provided by the general annual surveys (CFS and/or MNR). $25.0

6.2 Conduct short-term, problem-oriented studies on pest problems requiring immediate attention (CFS and/or MNR). $20.0

For example: Evaluation of pest problems in tree nurseries, seed orchards, plantations or high value stands.

Approach: In addition to research problems or needs already addressed in this program, new forest pest problems may occur. These pests may appear suddenly and create requests for immediate solutions. More intensive surveys will be conducted if the forest is considered to be of high value, and treatments recommended.

Resources: $45.0 as indicated in Chart "A".

13.7 Project No. CM-9.7 Forest Pest Control

Objective: To reduce damage caused to trees and forest stands by pests.

Problem/Need: There is a need to protect investments in forestry and forest renewal from depletion. Major pests identified as capable of causing significant

loss include dwarf mistletoes, jack pine budworm, spruce budworm, forest tent caterpillar, root and stem decay. There are special needs for:

7.1 Site specific and operational surveys for control purposes. (CFS/MNR) $10.0.

7.2 Protection of trees under intensive forest management as a result of the Canada/Manitoba Forest Renewal Agreement. This will include pests of nurseries, seed orchards, plantations, etc. (MNR/CFS). $20.0.

Approach: Operational surveys will be conducted in areas of known indemic populations of insect or disease that has the potential to cause timber volume loss. Co-ordination with regional forestry staff (MNR) is very critical to priorizing areas of concern. Appropriate prescriptions will be recommended after operational surveys.

Resources: $30.0 as indicated in Chart "A".

13.8 Project No. CM-9.8 Diagnostic and Advisory Services

Objective: To provide diagnostic and advisory services regarding tree and shrub insects and diseases.

Problem/Need: 8.1 Maintain and upgrade disease and insect reference collections and provide specialized identification and taxonomic services. (CFS) $5.0

8.2 Transfer pest/forest management information to resource managers and other users. (CFS) $5.0.

8.3 Plan for continuing technology transfer and training of operational staff. (CFS/MNR) $5.0.

8.4 Produce manuals on diseases, insects and climatic effects. (CFS) $5.0.

Approach: Reference collections of forest insects and diseases have been established and upgraded annually. They now contain more than 60,000 insect and 20,000 disease specimens.

Twenty-five pest leaflets for most common tree pests including control recommendations have been prepared.

File reports on pest conditions, Information Reports, Forest Pest Management Notes, etc. are prepared annually.

Training sessions on forest pests will be provided for provincial forestry and parks personnel, forestry industry personnel, etc.

Publish "A pictorial guide to forest and shade tree insects of the Canadian Prairies", 1986 (CFS)

Publish "A pictorial guide to forest and shade tree diseases of the Canadian Prairies", 1986-87 (CFS)

Publish pictorial guide on "Frost damage to conifers", (CFS).

Others as required.

Resources: $20.0 as indicated in Chart "A".

14.0 FOREST ENVIRONMENT (CM-10) EXECUTIVE SUMMARY

FOREST/ENVIRONMENT RESEARCH

AERIAL SPRAYING OF HERBICIDES - ECOLOGICAL IMPACT

	Fiscal Year	Staff Cont.	Staff Summ.	Budget ($000's) Salary	O&M	Total
(i) Effects of aerial spraying on target and non-target vegetation	1985	1	-	26.0	5.0	31.0
	1986	1	-	26.5	5.0	31.5
	1987	1	-	27.0	5.0	32.0
Effects of aerial spraying	Total	3 yrs.		79.5	15.0	94.5
(ii) Aerial spraying on aquatic ecosystems. Monitor the deposition of aerial spraying of herbicides on aquatic ecosystems. Monitor the indirect effects of aerial spraying on the aquatic biota-(algae, zooplankton, fish). The information will be used to aid in the development of reforestation guidelines related to the aerial spraying of herbicides.	1985	1	1	30.0	15.0	45.0
	1986	1	1	30.5	16.0	46.5
	1987	1	1	31.0	17.0	48.0
	Total	3 yrs	3 summ.	91.5	48.0	139.5
TOTAL HERBICIDES				171.0	63.0	234.0

14.1 Project No. Cm-10.1 Aerial Srpaying of Herbicides - Ecological Impact

Objective: To determine the environmental impact of the aerial spraying of herbicides in forest management from an ecological perspective.

Problem/Need: The aerial application of herbicides is used to enhance growth of conifer regeneration and plantations by eliminating competition from herbaceous undergrowth and deciduous trees.

The Manitoba Environmental Management Division (EMD) has a concern for the ecological effects of herbicide spraying. Abitibi-Price Inc. used aerial spraying of

herbicides on approximately 1300 hectares of forest in 1983 and plans a similar program in 1984.

Manitoba Forestry Resources Limited (MANFOR) intends to initiate field trials for aerial spraying of herbicides in 1984.

In 1983 EMD received concerns from the public regarding the effects of the Abitibi-Price Inc. spray program on aquatic ecosystems.

Information is required on the environmental effects of the aerial spraying of herbicides on an ecological base.

Approach: This is a new program designed to assess effectiveness of the spray program on target and non-target areas.

Target vegetation will be monitored in sprayed and control areas over a 3-year period to provide a detailed evaluation of herbicide effects to target species.

Non-target vegetation will be monitored and indirect effects to environmental concerns for wildlife habitat will be evaluated.

Aquatic ecosystems will be monitored for herbicide deposition and persistence in surface waters adjacent to designated spray areas.

Ecological effects of herbicide spraying on aquatic biota will be evaluated including algae, zooplankton,

and fish.

In addition the net loss of herbicides from the land to aquatic systems via surface runoff will be studied.

Resources: (a) Effects on vegetation

* Technical position - contract for 3 years	79.5
* Operating and Maintenance - 5.0 for 3 years	15.0
Total vegetation	94.5
(b) Effects on Aquatic Ecosystems	
* Technical positions - contract for 3 years	79.5
* Summer students - 4 mos. for 3 years	12.0
* Operating and Maintenance	48.0
Total aquatics	139.5
Total herbicide project	234.0

Total funding by year: 1985 - 76.0

1986 - 78.0

1987 - 80.0

15.0 APPENDIX 1 - COLLATION OF PROGRAM AREAS, PROJECTS, FIVE YEAR APPROVED FUNDING LEVELS

PROGRAM AREAS	PROGRAM NUMBERS	NUMBER OF FEDERAL STAFF PERSON YEARS	SALARIES OF STAFFING ($000's)	OPERATIONAL COSTS ($000's)	TOTAL FIVE YEAR COSTS ($000's) BY PROGRAM AREAS	TOTAL FIVE YEAR COSTS ($000's) BY PROJECTS	PROJECT NUMBERS	PROJECT TITLES
Regeneration	CM-1	1	225.7	130.0	355.7	10.0	CM-1.1	Regional Reforestation Technical Committee-Technology Transfer
						120.0	CM-1.6	Hare Damage Risk Assessment
						225.7	CM-1.7	Guidelines-Aspen Conversion & Spruce Regeneration
Forest Nurseries	CM-2	-	-	220.0	220.0	10.0	CM-2.2	Technology Transfer - Nursery/ Greenhouse Management
						210.0	CM-2.7	Development of Large High Quality Stock
Site Classification	CM-3	1	225.7	415.0	640.7	640.7	CM-3.1	Forest Management Site Classification System
Forest Inventory	CM-4	-	-	275.0	275.0	275.0	CM-4.1	Yield of Natural Stands
Yield of Managed Stands	CM-5	-	-	268.0	268.0	8.0	CM-5.1	Technology Transfer
						50.0	CM-5.2	Releasing White Spruce From Aspen-Biological Aspects
						70.0	CM-5.3	Releasing White Spruce From Aspen-Inventory Aspects
						80.0	CM-5.4	Releasing White Spruce From Aspen-Economic Aspects
						60.0	CM-5.5	Stand Tending Demonstrations
Fire Management	CM-6	1	225.7	85.0	310.7	225.7	CM-6.1	Information Transfer
							CM-6.2	Decision-aid Models
						85.0	CM-6.6	Fuel Type Mapping
Forest Economics	CM-7	1	225.7	317.0	542.7	204.2	CM-7.1	Northern Employment Development
						80.6	CM-7.2	Economics of Intensive Forest Management

15.0 APPENDIX 1 - COLLATION OF PROGRAM AREAS, PROJECTS, FIVE YEAR APPROVED FUNDING LEVELS

PROGRAM AREAS	PROGRAM NUMBERS	NUMBER OF FEDERAL STAFF PERSON YEARS	SALARIES OF STAFFING ($000's)	OPERATIONAL COSTS ($000's)	TOTAL FIVE YEAR COSTS ($000's) BY PROGRAM AREAS	PROJECTS	PROJECT NUMBERS	PROJECT TITLES
						30.1	CM-7.3	Damage Appraisal
						44.0	CM-7.4	Incentive & Regulations
						140.3	CM-7.5	Industrial Structure
						43.5	CM-7.6	Harvest Scheduling
Tree Improvement	CM-8	-	-	120.0	120.0	110.0	CM-8.3	Rooted Cutting Systems
						10.0	CM-8.4	Technology Transfer-Workshops
Insect and Disease	CM-9	1	225.7	330.0	555.7	60.0	CM-9.1	Impact of Pests and Damage Appraisal
						85.0	CM-9.2	Tree Mortality in Young Stands
						20.0	CM-9.3	Pest Survey Methods
						30.0	CM-9.4	Management of Pest Susceptible Forests
						40.0	CM-9.5	General Pest Surveys
						45.0	CM-9.6	Special Surveys
						30.0	CM-9.7	Forest Pest Control
						20.0 excludes staffing	CM-9.8	Diagnostic and Advisory Services
Forest Environment	CM-10	-	-	234.0	234.0	234.0	CM-10.1	Aerial Spraying of Herbicides Ecological Impact
A Total of Ten Program Areas		5	1,128.7	2,394.0	3,522.7 excludes the unbudgeted amount of 7.3		A total of thirty two projects	

TABLE 1: SUMMARY OF PROGRAM AREAS WITH MAIN EXPERIMENT NUMBERS, FEDERAL STAFF PERSON YEARS AND SALARIES, OPERATIONAL COSTS AND TOTAL BUDGET FOR FIVE YEARS

Program Experiment Number	Program Areas	Number of Federal Staff Person Years	Salaries of Staffing ($000's)	Operational Costs ($000's)	Total Budget ($000's)
*					
CM-1	Regeneration	1	225.7	130.0	355.7
CM-2	Forest Nurseries	0	-	220.0	220.0
CM-3	Site Classification	1	225.7	415.0	640.7
CM-4	Forest Inventory	0	-	275.0	275.0
CM-5	Yield of Managed Stands	0	-	268.0	268.0
CM-6(1)	Fire Management	1	225.7	85.0	310.7
CM-7(2)	Forest Economics	1	225.7	317.0	542.7
CM-8	Tree Improvement	0	-	120.0	120.0
CM-9	Insect & Disease	1	225.7	330.0	555.7
CM-10(3)	Forest Environment	0	-	234.0	234.0
Total Budget for 5 Years		5	1,128.7	2,394.0	3,522.7
Unbudgeted		-	-	-	7.3
TOTAL BUDGET		5	1,128.7	2,394.0	3,530.0

* The main program areas have been allocated with experiment numbers, CM-1 to CM-10 (CM = Canada/Manitoba). All the projects within the program areas will have numerical suffixes, example, CM-1.1 or CM-2.1, and so on.

(1) Fire Management is in the Regional Services Branch.
(2) Forest economics is in the Economics and Program Review Branch.
(3) Forest environment is in the Terrestrial Standards and Studies Section of the Environment and Workplace Safety and Health Branch.

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES WITHIN THE TEN PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
Regeneration	CM-1	CM-1.1	Regional Reforestation Technical Committee	F
		CM-1.2	Herbicide Research	-
		CM-1.3	Mechanization of Silviculture	-
		CM-1.4	Soil Modification - Site Preparation	-
		CM-1.5	Assessment of Volume and Yield Plots	-
		CM-1.6	Hare Damage Risk Assessment	F
		CM-1.7	Guidelines-Aspen Conversion & Spruce Regeneration	F
		CM-1.8	Assessment of McBorkan Seeder	-
		CM-1.9	Silvicultural Data	-
		CM-1.10	Long Term Site Productivity (Aspen)	-
Forest Nurseries	CM-2	CM-2.1	Production and Storage of Nursery Stock	-
		CM-2.2	Technology Transfer - Nursery/Greenhouse Management	F
		CM-2.3	Study of Effects of Seedbed Density	-
		CM-2.4	Study of Factors Affecting Overwintering	-
		CM-2.5	Assessment of Seed Grading & Seedling Culling	-
		CM-2.6	Study of Nutrient Effects on Hardening of Container Seedlings	-
		CM-2.7	Development of Large High Quality Stock	F
		CM-2.8	Problem Analysis of Herbicide Use in Nurseries	-
		CM-2.9	Study of Effects of Residual Fertility	-

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES WITHIN THE TEN PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
Site Classification	CM-3	CM-3.1	Forest Management Site Classification System	F
Forest Inventory	CM-4	CM-4.1	Yield of Natural Stands	F
Yield of Managed Stands	CM-5	CM-5.1	Technology Transfer	F
		CM-5.2	Releasing White Spruce From Aspen-Biological Aspects	F
		CM-5.3	Releasing White Spruce From Aspen-Inventory Aspects	F
		CM-5.4	Releasing White Spruce From Aspen-Economic Aspects	F
		CM-5.5	Stand Tending Demonstrations	F
		CM-5.6	Stand Tending Prescriptions for Jack Pine and Aspen	-
		CM-5.7	Regeneration Surveys	-
Fire Management	CM-6	CM-6.1	Information Transfer	F
		CM-6.2	Decision-aid Models	F
		CM-6.3	Wildfire Behaviour	-
		CM-6.4	Air Tanker Efficiency	-
		CM-6.5	Wildfire Prediction	-
		CM-6.6	Fuel Type Mapping	F
Forest Economics	CM-7	CM-7.1	Northern Employment Development	F
		CM-7.2	Economics of Intensive Forest Management	F
		CM-7.3	Damage Appraisal	F
		CM-7.4	Incentive and Regulations	F
		CM-7.5	Industrial Structure	F
		CM-7.6	Harvest Scheduling	F
Tree Improvement	CM-8	CM-8.1	Jack Pine Selection Based on Family Tests	-

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES AND FUNDING FOR NEW PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
		CM-8.2	Spruce Seed Orchards South of 53^0 N	-
		CM-8.3	Rooted Cutting Systems	F
		CM-8.4	Technology Transfer - Workshops	F
		CM-8.5	Provenance Test of Conifer Species	-
		CM-8.6	Spruce Seed Orchards North of 53^0 N	-
		CM-8.7	Second Generation Breeding of Jack Pine and Spruces	-
		CM-8.8	Trials of Hybrid Poplar Walker	-
		CM-8.9	Rejuvenation and Clonal Testing	-
Insect & Disease	CM-9	CM-9.1	Impact of Pests and Damage Appraisal	F
		CM-9.2	Tree Mortality in Young Stands	F
		CM-9.3	Pest Survey Methods	F
		CM-9.4	Management of Pest Susceptible Forests	F
		CM-9.5	General Pest Surveys	F
		CM-9.6	Special Surveys	F
		CM-9.7	Forest Pest Control	F
		CM-9.8	Diagnostic and Advisory Services	F
Forest Environment	CM-10	CM-10.1	Air Pollution Effects on Forest Regeneration	-
		CM-10.2	Air Pollution Effects on Forest Productivity	-
		CM-10.3	Peatland-Guidlines for Environmental Assessment	-
		CM-10.4	Remote Sensing-Landsat for Monitoring Forest Changes	-
		CM-10.5	Aerial Spraying of Herbicides	F

PART II

PROJECTS NOT FUNDED UNDER THE CANADA/MANITOBA FOREST RENEWAL AGREEMENT

1.0 INTRODUCTION

With the signing of the Canada/Manitoba Forest Renewal Agreement for the enhancement of forestry in Manitoba, a number of pertinent projects from ten program areas were formulated and developed. Though funding has been approved for the projects described in Part I, it is essential to keep the original proposal which in some cases are already funded under existing budget but which were not approved for additional funds, or in some cases not funded, in the perspective in which they were proposed. Consequently, this Part II of the MOU Research and Development Report has been included to encompass the remaining projects under the ten program areas.

In summary, 62 projects in 10 program areas were proposed for the five year funding considerations over the period 1984-89. Of these 32 projects were approved for implementation as given in the table below, and described in Part I.

PROGRAM AREAS	NUMBER OF PROPOSED PROJECTS	NUMBER OF PROJECTS APPROVED FOR FUNDING AS DESCRIBED IN PART I
Regeneration	10	3
Forest Nurseries	9	2
Site Classification	1	1
Forest Inventory	1	1
Yields of Managed Stands	7	5
Fire Management	6	3
Forest Economics	6	6
Tree Improvement	9	2
Insect and Disease	8	8
Forest Environment	5	1
TOTAL (10)	62	32

2.0 SUMMARY OF ONGOING PROJECTS

There are a total of 30 projects that are ongoing and these are described in the same format as in Part I. Table 2 is repeated for ease of reference.

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES WITHIN THE TEN PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
Regeneration	CM-1	CM-1.1	Regional Reforestation Technical Committee	F
		CM-1.2	Herbicide Research	-
		CM-1.3	Mechanization of Silviculture	-
		CM-1.4	Soil Modification - Site Preparation	-
		CM-1.5	Assessment of Volume and Yield Plots	-
		CM-1.6	Hare Damage Risk Assessment	F
		CM-1.7	Guidelines-Aspen Conversion & Spruce Regeneration	-
		CM-1.8	Assessment of McBorkan Seeder	-
		CM-1.9	Silvicultural Data	-
		CM-1.10	Long Term Site Productivity-Aspen	-
Forest Nurseries	CM-2	CM-2.1	Production & Storage of Nursery Stock	-
		CM-2.2	Technology Transfer Nursery/Greenhouse Management	F
		CM-2.3	Study of Effects of Seedbed Density	-
		CM-2.4	Study of Factors Affecting Over-wintering	-
		CM-2.5	Assessment of Seed Grading & Seedling Culling	-
		CM-2.6	Study of Nutrient Effects of Hardening of Container Seedlings	-

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES WITHIN THE TEN PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
		CM-2.7	Development of Large High Quality Stock	F
		CM-2.8	Problem Analysis of Herbicide Use in Nurseries	-
		CM-2.9	Study of Effects of Residual Fertility	-
Site Classification	CM-3	CM-3.1	Forest Management Site Classification System	F
Forest Inventory	CM-4	CM-4.1	Yield of Natural Stands	F
Yield of Managed Stands	CM-5	CM-5.1	Technology Transfer	F
		CM-5.2	Releasing White Spruce From Aspen Biological Aspects	F
		CM-5.3	Releasing White Spruce From Aspen Inventory Aspects	F
		CM-5.4	Releasing White Spruce From Aspen Economic Aspects	F
		CM-5.5	Stand Tending Demonstrations	F
		CM-5.6	Stand Tending Prescriptions for Jack Pine and Aspen	-
		CM-5.7	Regeneration Surveys	-
Fire Management	CM-6	CM-6.1	Information Transfer	F
		CM-6.2	Decision-aid Models	F
		CM-6.3	Wildfire Behaviour	-
		CM-6.4	Air Tanker Efficiency	-
		CM-6.5	Wildfire Prediction	-
		CM-6.6	Fuel Type Mapping	F

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES WITHIN THE TEN PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
Forest Economics	CM-7	CM-7.1	Northern Employment Development	F
		CM-7.2	Economics of Intensive Forest Management	F
		CM-7.3	Damage Appraisal	F
		CM-7.4	Incentive and Regulations	F
		CM-7.5	Industrial Structure	F
		CM-7.6	Harvest Scheduling	F
Tree Improvement	CM-8	CM-8.1	Jack Pine Selection Based on Family Tests	-
		CM-8.2	Spruce Seed Orchards South of 53^0 N	-
		CM-8.3	Rooted Cutting Systems	F
		CM-8.4	Technology Transfer - Workshop	F
		CM-8.5	Provenance Test of Conifer Species	-
		CM-8.6	Spruce Seed Orchards North of 53^0 N	-
		CM-8.7	Second Generation Breeding of Jack Pine and Spruces	-
		CM-8.8	Trials of Hybrid Poplar Walker	-
		CM-8.9	Rejuvenation and Clonal Testing	-
Insect & Disease	CM-9	CM-9.1	Impact of Pests & Damage Appraisal	F
		CM-9.2	Tree Mortality in Young Stands	F
		CM-9.3	Pest Survey Methods	F
		CM-9.4	Management of Pest Susceptible Forests	F

TABLE 2: SUMMARY OF PROPOSED PROJECT TITLES WITHIN THE TEN PROGRAM AREAS

PROGRAM AREAS	PROGRAM NUMBERS	PROJECT NUMBERS	PROPOSED PROJECT TITLES	FUNDING APPROVED FOR 1984-89 (F)
		CM-9.5	General Pest Surveys	F
		CM-9.6	Special Surveys	F
		CM-9.7	Forest Pest Control	F
		CM-9.8	Diagnostic & Advisory Services	F
Forest Environment	CM-10	CM-10.1	Air Pollution Effects on Forest Regeneration	-
		CM-10.2	Air Pollution Effects on Forest Productivity	-
		CM-10.3	Peatland-Guidelines for Environmental Assessment and Reclamation	-
		CM-10.4	Remote Sensing - Landsat for Monitoring Forest Change	-
		CM-10.5	Aerial Spraying of Herbicides	F

3.0 REGENERATION (CM-1) - EXECUTIVE SUMMARY

Seven silviculture-related projects are ongoing and presented in order of priority.

CM-1.2 Herbicide Research - Joint CFS/MNR

- ongoing CFS R & D
- ongoing MNR R & D

CM-1.3 Mechanization of Silviculture - Joint CFS/MNR

- ongoing CFS R & D TT
- ongoing MNR R & D TT

CM-1.4 Soil Modification - Site Preparation

Joint CFS/MNR

- ongoing CFS R & D

- ongoing MNR R & D

CM-1.5 Assessment of CFS Volume & Yield Plots - CFS

- ongoing CFS R & D

CM-1.8 Assessment of McBorkan Seeder - MNR

- ongoing MNR R & D

CM-1.9 Silviculture Data - Manitoba - Joint CFS/MNR

- ongoing CFS TT

- ongoing MNR TT

- 0.5 - 5 year term PY 30K annually

CM-1.10 Long Term Site Productivity (Aspen) - CFS

- ongoing CFS R & D

3.1 Project No. CM-1.2: Herbicide Research

Objective: To identify and test herbicides which show promise for use as silvicultural tools in control of unwanted vegetation throughout the establishment and early development stages of new forests.

Problem/Need: Manitoba has large areas of productive forest lands which are difficult to reforest and manage effectively unless some economical methods of controlling unwanted competing vegetation, within tolerable limits of ecological safety, can be found.

Herbicides appear to offer promise as tools for this job but considerable R & D is necessary to introduce them in an effective and environmentally sound manner.

Approach: A variety of herbicides are currently available for possible forestry use. Some are formally registered for that purpose and some are not. Research has been initiated by the CFS in the effectiveness of some of these products in controlling unwanted vegetation on forest land. More such research is needed and must be conducted within the framework of a well developed rationale including identification of areas where such treatments are most needed, and development of prescriptions for herbicide uses in specific cases such as site preparation, or conifer release. This would include herbicide type, dosage, and timing and method of application. Special care should be taken to assure environmental effects of herbicides, including effects on fish and wildlife populations. Aerial application is of special concern and should be carefully researched to justify its use on forest land.

Resources: Ongoing Joint CFS/MNR R & D

CFS	ongoing	0.3 PY	$1,500.00
MNR	ongoing	0.5 PY	$1,500.00

3.2 Project No. CM-1.3: Mechanization of Silviculture

Objective: To determine the availability of machinery suitable for silvicultural work, particularly for site preparation, and to evaluate the effectiveness of such machines in achieving silvicultural objectives.

Problem/Need: Large scale harvesting of forest crops, as well as forest depletion by fire, insects and diseases, creates the need for silvicultural operations of comparable size, which in turn requires a high degree of mechanization requiring use of machines such as drum choppers, disc trenchers, C & H plows, and spot scarifiers. The availability of such machines and their effectiveness in achieving silvicultural objectives - such as adequate site preparation before seeding or planting - are of major concern to both provincial and federal forestry agencies. For example, the machines used can affect reforestation success through impacts on seedbed condition and future seedlings performance. Such effects may well vary with terrain, soil type and condition, and season of year.

Approach: The CFS has a National Mechanization of Silviculture Program centered at Great Lakes Forest Research Centre (GLFRC) in Sault Ste. Marie, Ontario. In 1981, the NoFRC established a regional component

of this program and became a member of the National Committee on Mechanization (NACMEC). Since that time NoFRC has undertaken, in co-operation with provinces in the Region, including Manitoba, a detailed inventory of equipment, and a variety of evaluation trials in co-operation with GLFRC. This work with GLFRC and the provinces should continue and will include workshops as well as field evaluation and inventory components.

Resources: Ongoing Joint CFS/MNR Technology Transfer R & D

CFS	ongoing TT	0.2 PY	$1,500
	ongoing R&D	0.1 PY	$1,000
MNR	ongoing TT	0.1 PY	$1,000
	ongoing R&D	0.2 PY	$1,500

3.3 Project No. CM-1.4: Soil Modification - Site Preparation

Objective: To study soil modification resulting from logging and site preparation prior to establishing new forest crops by: a) determining the impact of current logging and site preparation techniques upon soil factors and subsequent seedling growth, and b) developing alternative methods of both logging and site preparation where current and past methods have adverse effects.

Problem/Need: There is a well-documented need for reforestation of cutover and otherwise non-productive forest land in Manitoba. Such work requires mech-

anical treatment of many areas and such treatment may result in varying impacts on soil compaction, erosion, drainage alteration and nutrient cycling, thereby possibly adversely affecting the long term productivity of the new forest. Some practices may also increase vegetative competition. Such potential effects should be studied for the most common logging and site preparation equipment in order to identify possible problems and find improved techniques.

Approach: R & D should be undertaken as part of ongoing CFS work, with co-operation of Manitoba staff in identifying field sites and for providing specific treatment combinations on sites. The work should be co-ordinated with the mechanization of silviculture work (priority 3).

Resources: Ongoing Joint CFS/MNR R & D

- ongoing	CFS R & D	0.2 PY	$2,000
- ongoing	MNR R & D	0.1 PY	$ 500

3.4 Project No. CM-1.5: Assessment of Volume and Yield Plots

Objective: To assess existing CFS plots in Manitoba in order to obtain a first approximation of the growth and yield benefits of plantation, particularly in White Spruce and to make the information available to forest managers in Manitoba for future application.

Problem/Need: There is a lack of data on the growth and yield performances of Manitoba plantations and a

need for an assessment of available long-established plots to help remedy this situation. Information required includes:

a) determination of growth rate and production capabilities of planted forests;

b) determination of effects of cultural practices at different stages of stand development and identification of most desirable practices;

c) continue plot monitoring in the future (1984-89).

Approach: There are a variety of plots which have been established in Manitoba plantations by the CFS in the past. Varying amounts of assessment, analysis and reporting have been undertaken by the CFS and should be continued and increased in the future. Also, a workshop of stand tending and plantation performance should be undertaken in Manitoba to provide transfer of available knowledge in 1984.

Resources:

ongoing	CFS R & D and TT		
ongoing	CFS R & D	0.2 PY	$1,500

3.5 Project No. CM-1.7: Guidelines - Aspen Conversion and Spruce Regeneration

Objective: To develop guidelines for conversion of Aspen and Aspen/Spruce stands to White Spruce, and to increase success of White Spruce regeneration following current and future White Spruce harvesting.

Problem/Need: There are large areas of highly productive forest land which would be suitable for White Spruce production but are dominated by Aspen, either as a result of past harvesting or fire. The amount of such land is steadily increasing because of ineffective conversion techniques and current harvesting and site management practices. Such techniques and practices require review and modification if these productive sites are to be successfully regenerated to White Spruce.

Approach: The CFS has done considerable work on Aspen and White Spruce in Manitoba in the past such as that of Haig and Jarvis and the MS-238 project at Pine Falls. This work should be remeasured, analysed and reported through a Silvicultural Specialist hired under the Agreement.

Resources: 1-5 year term PY and $40,000 annually.

3.6 Project No. CM-1.8: Assessment of McBorkan Seeder

Objective: To assess the suitability of the McBorkan air seeder for use in artificial seeding in Manitoba.

Problem/Need: The Province of Manitoba has been carrying out seeding trials with a specially designed air seeder mounted on the back of a skidder and disc trencher. There are needs:

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Forestry research plan for Manitoba, 1984-89

a) to assess the suitability of an air seeder for seeding Spruce in inaccessible Spruce cutovers during fall and winter;

b) to determine the quantity of seed to obtain full stocking on Spruce areas by mechanical air seeder;

c) to determine the quantity of seed to obtain full stocking on Spruce areas using hand-spot seeding techniques;

d) to determine the type of seed that is required for seeding.

Approach: Seeding trials have been going on with this air seeder for three years and measurements are presently in progress on specifically designed areas to ascertain the results. It is a responsibility of the Province of Manitoba to complete this research under existing funding.

Resources: ongoing MNR R & D

MNR 0.1 PY $ 500.

3.7 Project No. CM-1.9: Silviculture Data

Objective: To obtain and report silviculture data from Manitoba as part of the national report on Silviculture Statistics for Canada.

Problem/Need: The status of silviculture in Canada - both scale and success - must be known in order to assess progress toward future forest management and production goals. Such information is only avail-

able from individual provinces or territories and is useful to both provincial and federal agencies for planning purposes, particularly where federal-provincial initiatives in forestry are concerned.

Approach: At present the collection and reporting of silvicultural data for Canada is a function delegated to NoFRC under the national statistics program at Petawawa National Forestry Institute (PNFI). Under the arrangement, Manitoba provides data to the CFS, who analyse and report it. A more complete data set called Change Data - of which the current silvicultural data is only a part - would be beneficial, and if it were to be successfully obtained, would require a provincial term PY under the Agreement.

Resources: ongoing and new Joint CFS/MNR TT

ongoing	CFS	0.1 PY	$ 500
ongoing	MNR	0.1 PY	$ 500
New			
MNR	0.5	5-year term PY	$30,000 annually

3.8 Project No. CM-1.10: Long Term Site Productivity (Aspen)

Objective: To determine the long-term productivity effects of the removal of varying amounts of biomass from Aspen sites during harvesting operations.

Problem/Need: The long-term productivity effects of Aspen harvesting operations, especially those which remove the total tree, or the total tree including stump and root system as might be considered for biomass production, are not well known and could be significant to future production goals for Aspen or other species like White Spruce.

Approach: The CFS supervised a 3-year contract to obtain basic data on nutrient budgets in Aspen stands in the boreal mixedwood zone of Alberta. Results should be relevant to Manitoba. A computer model (FORCYTE II) has been developed under a separate ENFOR contract and will allow the Aspen data to be modelled to predict long-term effects of varying degrees of removal upon site productivity.

Resources: ongoing CFS R & D 0.1 PY $ 500.

4.0 FOREST NURSERIES (CM-2) - EXECUTIVE SUMMARY

Seven forest nursery-related studies are ongoing; these are presented below in order of priority.

CM-2.1 Production and storage of nursery stock - Joint CFS/MNR

- ongoing CFS, TT and R & D

CM-2.3 Study of effects of seedbed density - CFS

ongoing CFS R & D

CM-2.4 Study of factors affecting overwintering - CFS

ongoing CFS R & D

CM-2.5 Assessment of seed grading and seedling culling

Joint CFS/MNR

- ongoing CFS TT and R & D
- ongoing MNR R & D

CM-2.6 Study of nutrient effects on hardening of container seedlings

Joint CFS

- ongoing CFS R & D
- ongoing MNR R & D
- New under Agreement - foliar analysis equipment - 20K

CM-2.8 Problem analysis of herbicide use in nurseries - CFS

- ongoing CFS R & D

CM-2.9 Study of effects of residual fertility - CFS

- ongoing CFS R & D

4.1 Project No. CM-2.1: Production and Storage of Nursery Stock

Objective: To assess and improve upon facilities, procedures and practices used in the production and storage of nursery stock.

Problem/Need: Manitoba is expanding both container and bareroot production facilities to meet new demands for both quality and quantity of planting stock. These new demands affect both established and new

production facilities. There are special needs for:

a) assessment of practices in established nurseries, including stock monitoring, lifting and storage procedures;

b) assessment of containers as potential transplant stock;

c) examination of design/performance criteria for greenhouses at The Pas and suggestions for modification;

d) assessment of the Clearwater Nursery site at The Pas for development of a bareroot nursery to produce 1 to 3 million seedlings per year.

Approach: CFS staff at NoFRC have ongoing commitments to liaison and technology transfer which relate directly to this priority. It is important to note research into stock monitoring and into factors affecting seedling dormancy, which is of particular relevance to lifting and storage procedures, is underway at NoFRC. A variety of consulting firms and provincial and industrial nursery experts are available to Manitoba as sources of information on nursery facilities and procedures in addition to CFS staff.

Resources: This is a joint CFS/MNR project with new MNR staff requirements under the Agreement.

ongoing	CFS TT	0.1 PY	$1,000
Research-Development		0.1 PY	$1,500

New MNR-Operational (R & D)

5-year term prof. nursery specialist

1.0 PY		$40,000
Nursery technician	1.0 PY	$20,000

4.2 Project No. CM-2.3: Study of Effects of Seedbed Density

Objective: To determine the effects of seedbed density upon the growth and development of bareroot stock and to implement practices to realize potential improvements.

Problem/Need: Seedbed density, along with fertility factors, is a major determinant of growth and development of nursery-grown seedlings and more knowledge of this factor has the potential to reduce production costs and improve stock quality significantly.

Approach: CFS staff at NoFRC initiated a study on this subject 3 years ago, one part of which is located in Manitoba, where Manitoba staff have co-operated in maintaining and measuring the plots. Data are now available for both Pine and Spruce. NoFRC staff will analyse and report the results of this study and make them available to Manitoba so that they can implement the procedures in their October 1984 sowing program.

Resources: ongoing CFS R & D 0.1 PY $ 500.

4.3 Project No. CM-2.4: Study of Factors Affecting Overwintering

Objective: To undertake research into factors affecting success of outdoor overwintering of stock, and apply

results to improve upon current practices.

Problem/Need: Considerable seedling loss, both in mortality and reduced growth potential can occur during outdoor overwintering of planting stock at Manitoba nurseries, particularly in areas where snow cover is not dependable and where rapid temperature fluctuations occur. There is need for research to increase understanding of the physiology of cold hardening and dormancy, including the role of nutrients and endogenous cellular metabolites (hormones). There is also a need to remain up-to-date on current technology of storage.

Approach: CFS staff at NoFRC are currently conducting relevant research into plant physiology and nutrition as it affects cold hardening/dormancy on species of interest to Manitoba. Tests of monitoring procedures for assessing cold hardening and dormancy of a number of regional conifers (including Root Growth Potential) are also underway.

A recent bareroot monitoring questionnaire under the auspices of the Regional Reforestation Technical Committee will be analysed and reported by the NoFRC. The initial results of research and up-to-date information on storage technology could be included in approaches noted under Priority 2.2.

Resources: ongoing CFS R & D 0.2 PY $3,500

4.4 Project No. CM-2.5: Assessment of Seed Grading and Seedling Culling

Objective: To assess grading and seedling culling and grading practices as well as seedling standards at the nursery gate in order to develop improved procedures and practices for both container and bareroot stock.

Problem/Need: Seed grading and consequent knowledge of seed quality can result in economy and improved quality at all phases of seedling production. It may have a particular bearing on culling requirements and general seedling quality and uniformity. However, prior to concerns about seed grading, every effort should be made to collect the highest quality seed possible, whether from seed collection areas, seed production areas, or seed orchards. Seedling culling and grading constitute major areas of potential personnel and production costs. Any reduction in culls and increased quality of stock would be a significant benefit to Manitoba nurseries. To assess seedling culling and grading, a basic understanding of the morphological quality of the stock is required. After morphological grades are established, stock should be monitored on an annual basis to see if quality is increasing or decreasing. A clear statement of seedling standards, based on

specific site requirements (i.e. a part of silvicultural prescriptions) would be a major help to nurserymen, as they would then grow and monitor stock to meet specific goals.

Approach: Seed grading could be assessed as a technology transfer item either under Priority 2.2 meeting or through the Regional Reforestation Technical Committee which meets in Alberta in 1984. Quality testing methods are available; Alberta uses the technique. In addition, the recent stock monitoring questionnaire sent out by the Regional Reforestation Technical Committee (see Priority 2.4) will provide some information relevant to culling and grading and seedling standards in Manitoba.

Manitoba is currently drafting a report on culling and grading procedures. CFS staff at NoFRC will provide comments on this report at Manitoba's request. In the long run, if ecological site classification procedures are established and prescriptions reflecting required stock standards are developed by silviculturists, nurserymen will be able to respond to these standards with refined production and monitoring methods. Site-specific feedback from the field will be a valuable source of information for futher refinement. This will give the entire area of seedling culling and grading a much clearer

frame of reference than currently exists.

Resources: Joint CFS/MNR ongoing CFS R & D and TT covered under Priorities 2.2 and 2.4

- ongoing MNR R & D 0.1 PY $1,000.

4.5 Project No. CM-2.6: Study of Nutrient Effects on Hardening of Container Seedlings

Objective: To assess nutrient regimes as they affect growth and hardening phases of container seedlings in order to develop improved container stock.

Problem/Need: Nutrient requirements are a critical aspect of production schedules for container seedlings and refinements are needed, particularly for Black Spruce in Manitoba. Analytical methods and equipment are needed to support the schedules.

Approach: CFS staff at NoFRC will undertake research addressing the effect of nutrients on hardening of containerized Black Spruce. Manitoba has developed refinements to existing CFS schedules for Black Spruce and CFS will advise on such refinements as required. Manitoba could benefit by obtaining foliar analysis equipment for production monitoring, under the Agreement. NoFRC continues to offer laboratory analysis services on soils and foliage for Manitoba nurseries to address longer-term management plans. Some of the needs under Priority 2.6 can be addressed through technology transfer under Priority 2.2.

Resources: Joint CFS/MNR R & D

- ongoing CFS R & D 0.2 PY $1,000
- ongoing MNR R & D 0.1 PY $ 500
- foliar analysis equipment - 20K.

4.6 Project No. CM-2.8: Problem Analysis of Herbicide Use in Nurseries

Objective: To undertake problem analysis on herbicide use in nurseries and report results to Manitoba for operational testing and application.

Problem/Need: Weed control is a major cost in nursery production. There is a need to assess the state-of-art herbicide use in forest nurseries and to make recommendations relevant to Manitoba conditions. A complete study of the problem would require field tests in the nursery and bioassays in the greenhouse for both established and new proposed herbicides. Soil residue studies would also be required before nurseries get into herbicides in a big way.

Approach: CFS staff at NoFRC will undertake a problem analysis of herbicide use in nurseries. The workshop under Priority 2, in 1985, would be useful for reporting results, after which operational testing and application could be undertaken by Manitoba, with CFS advice.

Resources: ongoing CFS R & D TT (under Priority 2.2)

R & D 0.1 PY $1,500.

4.7 Project No. CM-2.9: Study of Effects of Residual Fertility

Objective: To determine the effects of residual fertility on successive crops of bareroot seedlings and report results for application in Manitoba nurseries.

Problem/Need: The level of residual fertility in bareroot nursery beds, in relation to fertilizer application rates and utilization rates by seedlings is an important aspect of nursery soil management. The interaction between seedbed fertility and seedling density is a particularly important determinant of seedling growth and development.

Approach: CFS staff at NoFRC have an ongoing study of residual fertility which should be completed and reported by 1987/88. Initial results could be effectively reported at workshops under Priority 2 as they become available.

Resources: ongoing CFS R & D and TT (under Priority 2)

R & D 0.1 PY $1,500

5.0 YIELD OF MANAGED STANDS (CM-5) - EXECUTIVE SUMMARY

Two projects are ongoing as below:

CM-5.6 Stand tending prescriptions for Jack Pine and Aspen - ongoing CFS R & D TT

CM-5.7 Regeneration Surveys

- 1/2 - 5 year term PY $20,000

annually

5.1 Project No. CM-5.6: Stand Tending Prescriptions for Jack Pine and Aspen

Objective: Develop stand tending prescriptions for Jack Pine and Aspen.

Problem/Need: Spacing and thinning are basic to intensive forest management. Operational implementation of such silvicultural practices by the field forester require easy to follow guidelines, or prescriptions.

Approach: There are a number of ongoing thinning and spacing studies in Jack Pine and Aspen (See NoFRC Study Statement NOR-04-045) at various locations in Manitoba established by the CFS to monitor growth and stand development following such treatments under a range of conditions. These studies are remeasured at certain intervals (viz., five or ten years) and the results are published as warranted. All this represents a pool of information for developing site specific stand tending prescriptions of Jack Pine and Aspen.

Resources: This is part of the CFS ongoing program and will be continued essentially unchanged.

ongoing CFS 0.1 PY $2,000

5.2 Project No. CM-5.7: Regeneration Surveys

Objective: Improve the effectiveness of regeneration surveys.

Problem/Need: Manitoba has recently updated its regeneration stocking standards and survey procedures, which are prescribed in a booklet entitled "Manitoba Forest Regeneration Manual". These surveys are used to evaluate stocking success during the regeneration period. They are expensive, and some streamlining, if feasible, may help reduce costs. Also, further analyses of regeneration data in terms of density (that is, number of trees/ha) - stocking percentage relationships for different conditions and treatments would help in formulating management guidelines and prescribing silvicultural treatments.

Approach: In a discussion of survey procedures at a meeting between CFS and the Manitoba Forestry Branch, it was suggested that the survey workload could be reduced substantially without any loss of useful information if a "quick and dirty" reconnaissance-type of post logging survey was conducted to assess regeneration change and to provide treatment prescription in lieu of the first year stocked-quadrat survey. The CFS is to undertake a brief review of the Manitoba forest regeneration manual and if warranted, suggest improvements in light of the Alberta experience.

Also, further analyses of regeneration data in terms of density-stocking percentage should be conducted and the results of such analysis presented in a format suitable for use by the field forester.

Resources: The CFS will conduct the review of the Manitoba regeneration manual as part of their ongoing technology transfer effort. Analysis of regeneration data may be conducted under a shared term position.

1/2 5-year term PY

$20,000 annually.

6.0 FIRE MANAGEMENT (CM-6) - EXECUTIVE SUMMARY

Three projects are identified as ongoing.

1) wildfire behaviour
2) air tanker efficiency
3) wildfire prediction.

CM-6.3 Wildfire behaviour

ongoing CFS R & D

CM-6.4 Air tanker efficiency

ongoing CFS (PNFI) R & D

0.1 PY 5-year term, total 0.5 PY $4,140 annually

CM-6.5 Wildfire prediction

ongoing CFS R & D

6.1 Project No. CM-6.3: Wildfire Behaviour

Objective: To improve the assessment and prediction of wildfire behaviour in terms and by methods which are useful to fire management agencies and to develop, evaluate, interpret and apply the Canadian Forest Fire Danger Rating System in the Province of Manitoba.

Problem/Need: Forest fire management is a costly and increasingly sophisticated undertaking. Suppression expenditures, in Western Canada, have exceeded 100 million dollars annually for the last few years. In Manitoba, 1,141,000 hectares of land have burned between 1980-83 inclusive. Central to cost-effective fire management is an understanding of fire behaviour in Manitoba fuel types. Research information that provides rate-of-fire spread, fire intensity, and crowning potential under a wide range of weather conditions and fuel types is necessary so that fire managers can select appropriate suppression alternatives and strategies consistent with available resources.

Approach: Fire behaviour and danger research is a major area of interest and effort, both nationally and regionally within the Canadian Forestry Service. The practical output of fire behaviour research to date has been a system of fire danger rating, providing daily codes and indexes on a relative basis.

Quantification of this system to produce estimated spread rates and intensities for the main forest cover types at any level of fire danger is underway. Fire behaviour information is currently available for upland Jack Pine, a troublesome fuel type in Manitoba. The CFS Fire Danger Group will provide Manitoba with an interim edition of the Canadian Forest Fire Behaviour Prediction System by June, 1984. The Fire Behaviour Prediction (FBP) system provides head fire rate of spread (ROS) vs. Initial Spread Index (ISI) relationships for 14 fuel types (7 coniferous, 1 deciduous, 2 mixedwood, 3 slash, 1 open). The report also includes a) ROS/ISI equations, graphs and tables, b) fuel type descriptions, c) adjustments and procedures, d) interpretations. The FBP system should be field tested against some of the major Manitoba fuel complexes over the next few years, resulting in necessary calibrations and modifications.

Resources: This is an ongoing national program carried out by the Canadian Forestry Service.

6.2 Project No. CM-6.4: Air Tanker Efficiency

Objective: To develop and execute a co-operative research program which will analyse current methods of air tanker dispatch, use and productivity, evaluate alternative basing, scheduling and attack technique

criteria, and test and adjust procedures to optimize the use of CL-215's in aerial fire suppression.

Problem/Need: The Canadian CL-215 replaced the Canso as the primary air tanker for forest suppression within the framework of the existing operational system. Additional CL-215's were acquired since the initial purchase and the fleet will increase again in the near future. The need to determine the air tanker's potential to operate economically and efficiently within the constraints of the province's geographic and organizational structure becomes more critical as the fleet size increases. The air tanker's productivity based on the Fire Weather Indices and fuel parameters has not been determined yet, all other suppression planning takes these facts into account. The limitations of operating a single air tanker or multiples have not been documented adequately to permit planning for optimal use. Bombing strategy must be analysed and appropriate adjustments implemented.

Approach: One of the requirements is an analysis of fire and fire weather history coupled with a review of the air tanker operation and mission accomplishments. The review must take into account base locations, time lapses due to ferrying and fire to lake distances and the resultant productivity achieved for given

indices and fuel parameters. Drop distributions under various fuel and environmental conditions based on load release sequence must be determined to facilitate the development of an operational strategy. The installation of precision intervelometers in the CL-215's will permit accurate door release sequencing.

Resources: This is an ongoing national program carried out by the Canadian Forestry Service. The resources will be provided by the Canadian Forestry Service (PNFI - Petawawa National Forestry Institute). In addition to this, 0.1 PY per annum will be required or 0.5 over the 5 years from the newly initiated 5 year research plan. This person will be used in Manitoba for co-ordination purposes.

6.3 Project No. CM-6.5: Wildfire Prediction

Objective: To initiate and conduct a co-operative research study which will provide an approach to predict forest fire incidence using lightning location, weather and fuel information.

Problem/Need: The Lightning Location and Protection System now in place in Manitoba provides information on each lightning stroke that has the potential to start a fire, however, it is impossible to check each stroke to determine if, in fact, ignition has taken place. It is necessary to develop criteria, based on fuel

type and condition, that are most likely to nurture ignition and to use this information to optimize utilization of the detection system.

Approach: Computer programs are currently available that use lightning location, fuel type and fuel condition data to predict lightning fire occurrence, however the data is, at this time, limiting. Extensive work is required to gather data on "arrival times" for a wide range of fuel types under differing conditions particularly moisture conditions. The information can be gathered in two ways: 1) by locating actual ignitions in a natural setting and recording the relevant data; 2) by igniting fuels artificially under a range of conditions and recording arrival times. Subsequently, accurate fuel maps, digitized for computer use will be required as well as a reliable network of fire weather stations to aid in documenting fuel conditions.

Resources: Some of this work is presently being conducted in Saskatchewan and for the most part is readily transferrable to Manitoba. Data is required on fuel types unique to Manitoba. Fuel mapping and weather networking are specific tasks to the Province of Manitoba. This is an ongoing national Canadian Forestry Service program.

7.0 TREE IMPROVEMENT (CM-8) - EXECUTIVE SUMMARY

Seven R & D and technology transfer studies have been identified as ongoing.

CM-8.1 Jack Pine selection based on family tests. Ongoing CFS with incremental (new) resourcing.

- 0.1 PY (professional) and $ 4,000
- 0.1 PY (seasonal) and $ 2,000
- micro-computer and data recorder $20,000

CM-8.2 Spruce seed orchards south of 53^0 N

- ongoing MNR

CM-8.5 Provenance tests of conifer species

- ongoing CFS and MNR

CM-8.6 Spruce seed orchards north of 53^0 N

New but using ongoing MNR staff

CM-8.7 Second generation breeding of Jack Pine and Spruces

* (MNR and CFS) beginning in 1987

- 1.0 1-year term (professional) CFS and MNR
- 2.0 1-year term (support) CFS and MNR

CM-8.8 Trials of Hybrid Poplar "Walker

- ongoing MNR

CM-8.9 Rejuvenation and clonal testing

- Contract (CFS-MNR) beginning 1987

$20,000 annually.

Note that CFS PY's and funding (Priorities 1 and 7) will come from the Jack Pine seed orchards establishment program. They are not additional requests for resources. However, the contracts (8.3 and 8.9) and workshop (8.4) require separate funding.

7.1 Project No. CM-8.1: Jack Pine Selection Based on Family Test Results

Objective: To select genetically superior Jack Pine trees for production of improved planting stock and for production of second generation progenies, based on results from the Eastern and Central Breeding District family tests.

Problem/Need: Jack Pine is an important reforestation species in Southeastern Manitoba and a potentially important species in Western Manitoba. Seed orchard establishment is underway in these areas, using results to date of family tests planted in 1972 and 1976. More accurate selection of the genetically best trees in these family tests and in a clone bank containing trees of the same families, requires continued periodic measurement of the four plantations constituting the Eastern Breeding District family test, and of the one Manitoba plantation of the Central Breeding District family test. Following statistical analysis, the new results will be used to upgrade the genetic quality

of established seed orchards or cutting orchards, and will eventually be used to select parents for breeding of second generation progenies.

Approach: The 10-year measurement of the Central Breeding District family test is scheduled for autumn of 1985 and the 15-year measurement of the Eastern Breeding District family test for autumn of 1986. Some measurement work may be done in other years, and additional major measurements will occur after this 5-year period. These measurements will be under the direction of CFS tree improvement staff in Edmonton, but assistance will likely be required from CFS staff in Winnipeg, and continued assistance from MNR will be welcome. Statistical analysis, selection, and reporting will be done by CFS staff in Edmonton.

Resources:		
	0.1 PY CFS Winnpeg professional	$ 4M
	0.1 PY CFS Winnipeg seasonal	$ 2M
	0.1 PY MNR support	$ 3M
	0.3 PY CFS Edmonton professional	$15M
	Micro-computer and data recorder purchase	$15M
	Operating costs, annual average	$ 5M

7.2 Project No. CM 8.2: Spruce Seed Orchards South of 53 O N

Ongoing R & D MNR

Objective: To produce genetically improved seed of Black Spruce and White Spruce for commercial plantations

in Manitoba south of 53^0 N.

Problem/Need: Black Spruce and White Spruce are major components of projected MNR reforestation activity. Most Spruce planting in the near term will be south of 53^0 N, hence genetic improvement of the seed supply is most urgent for this area.

Approach: Phenotypically superior trees are selected in natural stands. Grafts or seedling progeny from the selected trees are planted in seed orchards, which are treated to promote seed production. Progeny tests are planned to indicate the best clones or progenies in the seed orchards. This information will allow further genetic improvement.

Resources: 0.4 PY MNR professional

0.8 PY MNR support.

7.3 Project No. CM-8.5: Provenance Tests of Conifer Species

ongoing R & D MNR and CFS

Objective: To obtain information on geographic variation patterns of native and exotic species of coniferous forest trees.

Problem/Need: This priority comprises Manitoba components of national CFS provenance tests with Red Pine, Scots Pine, Jack Pine, and Black Spruce. Maintenance, measurement, and reporting on the Manitoba plantations is a responsibility of NoFRC to the national tree improvement program.

Approach: Maintenance of the plantations is carried out as required subject to available resources under CFS leadership with MNR assistance. Measurement is normally done at 5, 10, 15 and 25 years, followed by reporting when warranted by results, as time permits.

Resources:		
	0.1 PY CFS Edmonton professional	$5M
	0.1 PY CFS and MNR technical	$2M
	Travel	$1M

7.4 Project No. CM 8.6: Spruce Seed Orchards North of 53 ^{0} N

New R & D MNR

Objective: To produce genetically improved seed of Black Spruce and White Spruce for commercial plantations in Manitoba north of 53^{0} N.

Problem/Need: Commercial planting of Black Spruce and White Spruce is expected to increase north of 53^{0} N, although present seed requirements are less than for the southern part of the forest zone.

Approach: Procedures are expected to be similar to those used south of 53^{0} N. Work will proceed as resources are available.

Resources: 0.2 PY MNR professional

0.4 PY MNR support.

7.5 Project No. CM 8.7: Second Generation Breeding of Jack Pine and Spruces

New R & D MNR and CFS

Objective: To produce populations for the second generation of genetic improvement of planting stock, of Jack Pine for Southwestern Manitoba, and of Black Spruce and White Spruce south of 53^0 N.

Problem/Need: In the first generation of Jack Pine and Spruce breeding programs, trees genetically superior to ordinary planting are selected from natural populations to produce genetically improved planting stock. The genetic quality of planting stock can be further improved, in terms of plantation growth and yield, by selecting trees from the progenies of trees selected in the first generation. Before the second generation of improvement can begin, it is necessary to produce pedigreed populations descended from first generation selections.

Approach: Work on this priority will not begin until 1987. Jack Pine trees will be selected by analysis of the 15-year measurement of the family test. Second generation full-sib progenies will be produced by controlled matings in 1987 or 1988, among the selected trees. Selection and preparation of the mating plan will be done by CFS staff in Edmonton. Additional resources will be sought from CFS Winnipeg staff and MNR for implementation of controlled mating, rearing of progenies, and development of planting sites. Within-family assessment of the

second generation progenies will occur after this five-year period. Second generation breeding of the Spruces will begin with controlled mating of seed orchard trees.

Resources: (Annually beginning 1987)

0.5 PY professional CFS & MNR	$25M
1.0 PY support CFS & MNR	$25M
Operating costs	$10M

7.6 Project No. CM-8.8: Trials of Hybrid Poplar "Walker"

Ongoing R & D MNR

Objective: To determine the productivity of a particular hybrid Poplar clone ("Walker") on a variety of sites and under various management regimes in Manitoba.

Problem/Need: Tests of a number of Poplar cultivars in Manitoba identified "Walker" Poplar as being generally productive and suitable for culture in comparison with other cultivars. More information is required on yields in different circumstances to determine whether and how to use this clone for production of high-quality Poplar timber.

Approach: Test plantations have been and continue to be established on various sites in Southern Manitoba. Various management regimes are applied. Growth and yield are measured periodically.

Resources: 0.1 PY MNR professional

0.2 PY MNR support

Operating costs $6M

7.7 Project No. CM-8.9: Rejuvenation and Clonal Testing

New R & D MNR and CFS

Objective: (1) To root cuttings of Jack Pine, White Spruce and Black Spruce from trees 7-20 years of age, for genetic assessment and for commercial production of planting stock.

(2) To assess genetic quality of trees 7-20 years of age by observing performance of rooted cuttings from them.

Problem/Need: The genetic variation among individual trees within any progeny is usually greater than genetic variation among progenies. Part of the variation among individual trees is non-additive variation which can be captured only by using vegetative propagation of selected individuals. Any scheme to capture non-additive variation will require propagation of trees older than seedlings, hence more difficult to propagate vegetatively. Use of rooted cuttings for assessment of the non-additive as well as additive genetic quality of candidate trees will require designs and interpretation different from those used for progenies.

Approach: Existing techniques for rejuvenation, such as hedging and serial grafting, will be tried and adapted to Manitoba populations and conditions, and development of new methods may be attempted. Application of clonal testing, and commercial propagation of selected trees will not begin until after this initial 5-year period.

Resources: (Annually beginning 1987)

R & D contract $20M

8.0 FOREST ENVIRONMENT (CM-10) - EXECUTIVE SUMMARY

Five main projects have been identified and are summarized below in tabular form.

Project Description	Fiscal Year	Staff Contract	Staff Summer	Budget Salary	Budget O&M	Budget Total
10.1 Effects of Air Pollutants on Forest Regeneration						
-Metal contaminated soil in the Thompson area has been found to inhibit tree root growth	1985	1	1	30.0	10.0	40.0
-Manfor will initiate timber harvesting in the Thompson area in 1985, reforestation is required	1986	1	1	30.5	17.0	47.5
	1987	1	1	31.0	17.0	48.0
	1988	1	1	31.5	14.0	45.5
	1989	1		28.0	12.0	40.0
	TOTAL	5 yrs	4 summer	151.0	70.0	221.0
-EMD will determine pollutant effects and develop reforestation guidelines for contaminated sites.						

Project Description	Fiscal Year	Staff Contract	Staff Summer	Budget Salary	Budget O&M	Budget Total
10.2 Effect of Air Pollutants on Forest Productivity						
-EMD has initiated preliminary studies of Jack Pine growth through radial increment analysis, NoFRC has analysis equipment and facilities.	1985		1	26.0	5.0	31.0
	1986		1	26.5	5.0	31.5
	TOTAL		2 yrs.	52.5	10.0	62.5
-Information on productivity of merchantable species in the Thompson area is required to estimate reforestation potential.						
-EMD in co-operation with NoFRC to determine forest productivity in the Thompson and Flin Flon area.						
10.3 Peatland-Guidelines for EIA and Reclamation						
-Review guidelines and criteria uses in Canada and the northern USA	1985		1	26.0	3.0	29.0
	1986		1	26.5	3.0	29.5
	TOTAL		2 yrs.	52.5	6.0	58.5
-EMD in co-operation with NoFRC will develop EIA and management guidelines for peatlands of Manitoba.						
10.4 Remote Sensing Landsat for Monitoring Forest Change						
-To develop a provincial capability to use Landsat Imagery to monitor forest vegetation for air pollution effects from mining smelters.	1985		1	26.0	4.2	30.2
	TOTAL		1 yr.	26.0	4.2	30.2

Project Description	Fiscal Year	Staff Contract Summer	Budget Salary	O&M	Total
-EMD in co-operation with Manitoba Remote Sensing Centre to develop maps of vegetation change in the Thompson and Flin Flon areas.					
10.5 Aerial Sp aying of Herbicides-Indirect Effects on Wildlife Habitat					
-Effects of aerial spraying on wildlife habitat	1985	1	26.0	6.0	32.0
	1986	1	26.5	6.0	32.5
	TOTAL	2 yrs.	52.5	12.0	64.5

8.1 Project No. CM-10.1: Air Pollution Effects from Northern Mining Smelters on Forest Regeneration

Background: The Province of Manitoba, Environmental Management Division (EMD) and the Canadian Forestry Service, Northern Forest Research Centre (NoFRC) have determined that airborne emissions from northern mining smelters have resulted in heavy metal deposition to forest soils within 35 km of both Thompson and Flin Flon. In Thompson, greenhouse studies by EMD have shown that elevated levels of heavy metals within 5 km of the INCO smelter are inhibiting seedling root growth. Concern for forest regeneration in the area has been raised at Manitoba Clean Environment Commission hearings in 1982 and 1983.

Information on natural and artificial regeneration response to heavy metal contaminated soils is lacking; information on metal toxicity levels, metal distribution, and the effect on nutrient cycling is also required.

Manitoba Forestry Resources Ltd. (MANFOR) plans to initiate a major timber harvesting program in the Thompson area in 1985, and has been active in the Flin Flon area for many years; reforestation of harvested sites is required.

Objective: To develop recommendations and guidelines for reforestation of timber harvested areas on soils contaminated by airborne emissions of heavy metals from non-ferrous mining smelters in Northern Manitoba.

Problem/Need: Heavy metal deposition to forest soils occurs within 35 km of mining smelters at Thompson and Flin Flon and at elevated levels heavy metals in soils have been shown to inhibit growth and development of seedling roots.

A concern for forest regeneration in the Thompson area has been raised by EMD in reports to the Manitoba Clean Environment Commission.

MANFOR has recently released its 5-year operating plan indicating the commencement of timber harvesting in 1985 within deposition range of the INCO smelter.

Similarly, harvest sites in the Flin Flon area are within deposition range of the HBM&S smelter. Information is needed on the distribution of smelter emissions in the area to be harvested, the accumulation pattern in the soil profile, the potential for translocation of metal contaminants, the toxicity of heavy metals to forest species at various developmental stages and the effect of heavy metal contamination on nutrient recycling, all of which could directly and indirectly affect forest growth and productivity. A joint federal/provinial (NoFRC/EMD) forest research study has been carried out in the Thompson and Flin Flon areas since 1977 and expertise in the monitoring of heavy metal deposition and accumulation has been developed. EMD has carried out preliminary experimentation with heavy metal contaminated soils in greenhouse, laboratory, and field trials since 1980, and capability for chemical analysis is available. The proposed research is to be carried out by EMD over a 5-year period supplemented by 1 technical position for the duration and a summer student for the first 4 years.

Resources:	*Technical staff-contract for 5 years	$135.0
	*Summer students-4 mos. for 4 years	$ 16.0
	*Operating & maintenance-70.0 for 5 years	$ 70.0
	TOTAL	$221.0

RESEARCH PLAN - SMELTER EMISSION EFFECTS ON NATURAL REGENERATION

Year		Staff	O & M
1985	*Descriptive Soil Survey of Joey L and Thompson cutting areas.	1.0 PY	10.0
	*General Soil Analysis Survey of Joey L. and Thompson areas.	1 summer	
	*Ecological Assessment of Forest Communities as Joey L. and Thompson.		
	*Compile and Analyse Soil and Vegetation Data for 5-year plan.		
	*Prepare a Detailed Planning Map for Veg. and Soil Studies.		
	*Develop and Initiate Monitoring for Heavy Metal Deposition in Joey L. Cutovers.		
	*Plan and Select Seed Sources for Field Trials 1986-1987.		
1986	*Detailed Soil Analysis Survey of Joey L. and Thompson areas.	1.0 PY	17.0
	*Initiate Natural Regeneration Surveys-Joey L. Cutovers.	1 summer	
	*Initiate Greenhouse Studies of Soil Toxicity Effects on Seedlings.		
	Initiate Soil Studies - Heavy Metal Toxicity, Nutrient Cycling, Migration.		
	*Initiate Field Trials Joey L. Seed and Seedlings.		
	*Continue Heavy Metal Deposition Monitoring Joey L., Initiate in Thompson Cutovers.		

Year		Staff	O & M
1987	*Initiate Natural Regeneration Surveys-Thompson Cutovers.	1.0 PY	17.0
	*Continue Soil Studies - Heavy Metal Toxicity, Nutrient Cycling, Migration.	1 summer	
	*Continue Field Trials - Joey L. Initiate Field Trials - Thompson Cutovers.		
	*Continue Heavy Metal Monitoring Joey L. and Thompson Cutovers.		
	*Select Sites and Carry Out Descriptive Soil Survey in Flin Flon area.		
	*General Soil Analysis Survey of Flin Flon Sites.		
	*Initiate Heavy Metal Monitoring on Flin Flon Sites.		
1988	*Continue Field Trials-Joey L. and Thompson Cutovers.	1.0 PY	14.0
	*Continue Heavy Metal Monitoring Joey L. and Thompson Cutovers.	1 summer	
	*Initiate Field Trials of Regeneration on Disturbed Sites - Fire and Mechanical.		
	*Continue Soil Toxicity Studies in Thompson; Initiate Studies in Flin Flon.		
	*Detailed Soil Analysis Survey of Flin Flon Sites.		
	*Compile Data and Initiate Reports on Greenhouse and Lab Studies.		

Year		Staff	O & M
1989	*Continue Heavy Metal Monitoring.	1.0 PY	12.0
	*Final Project Assessment Joey L., Thompson, Flin Flon.		
	*Final Project Assessment Soil Studies, Greenhouse and Laboratory.		
	*Final Project Assessment Field Trials, Regeneration on Disturbed Sites.		
	*Prepare Final Report - Joey L., Thompson, and Flin Flon.		
	*Prepare Reforestation Guidelines for Heavy Metal Contaminated Area Following Timber Harvesting		
	Totals	146.0	70.0

8.2 Project No. CM-10.2: Air Pollution Effects From Northern Mining Smelters on Forest Productivity

Background: Air pollutants emitted from non-ferrous mining smelters in Northern Manitoba have been investigated through a joint federal/provincial forest study since 1977.

Air pollutant impact has been documented in terms of sulphur dioxide effects on vegetation and heavy-metal contamination of forest soils.

Preliminary investigations of air pollution impact on forest productivity were initiated on a limited experimental basis in co-operation with the Ontario Ministry of Natural Resources in 1983/84. Manitoba Forestry Resources Ltd. (MANFOR) has recently released plans to initiate a major timber harvesting program in the Thompson area in 1985 and has been active in the Flin Flon area for many years. Information on air pollution impact on the productivity of mature forest stands in the vicinity of both smelting centres is required to estimate growth and development potential following reforestation operations.

Objective: To evaluate growth and productivity of merchantable species, within deposition range of airborne pollutants emitted from mining smelters at Thompson and Flin Flon, through radial increment analysis.

Problem/Need: Air pollution impact on forest vegetation and soils has been demonstrated by NoFRC and EMD and reported to the Manitoba Clean Environment Commission.

Forest harvesting is planned by MANFOR in the Thompson area in 1985 and has been ongoing in the Flin Flon area.

EMD has raised concern for reforestation of harvested sites as a result of greenhouse studies which demonstrated that soils with elevated heavy metal levels inhibit seedling root growth.

Preliminary growth studies of merchantable Jack Pine within close range of the Thompson smelter were initited in 1983 in co-operation with the Ontario Ministry of Natural Resources.

Follow-up studies of merchantable species within the designated cutting areas of MANFOR are required to determine productivity of reforested sites in both Thompson and Flin Flon.

Resources:		
	* Technical staff-contract for 2 years	$52.5
	* Operating & Maintenance-5.0 for 2 years	$10.0
	TOTAL	$62.5

8.3 Project No. CM-10.3: Peatland - Guidelines for Environmental Assessment & Reclamation

Background: The Province of Manitoba has considerable area of high quality peat; at present peatland is mined in the southeastern part of the province.

Since 1982, several proposals for expansion and new developments of peatland have been received by the Environmental Management Division including: the Cariboo Northeast Bog (N.W. Angle Forest), the Hay Point Bog (Hecla Island), and the Julius complex (Beausejour).

Information on environmental assessment of peatland developments and reclamation is required.

Objective: To review existing guidelines and management criteria in Canada and the northern United States and to use this information co-operatively with the Northern Forest Research Centre to develop reclamation guidelines for Manitoba.

Problem/Need: Manitoba peatlands are currently being mined and proposals for expanded and new developments are being received.

The Canadian Forestry Service has developed considerable expertise in the area of peatland ecology and has completed field work for baseline studies of peatland ecology, and quality in southeastern Manitoba.

Assistance is required to compile information on existing guideline criteria from provincial and state jurisdictions in Canada and the U.S. and to compile and develop guidelines specific to Manitoba.

Resources: * Technical position - contract for 2 years $52.5

* Operating & maintenance - 3.0 for 2 years $ 6.0

TOTAL $58.6

8.4 Project No. CM-10.4: Remote Sensing-Monitoring Change To Forest Vegetation from Air Pollution Emissions of Mining Smelters

Background: LANDSAT Imagery has been used by INCO Metals for assessment of vegetation effects from airborne emissions of non-ferrous smelters on an experimental basis.

INCO Metals contracted the Ontario Centre for Remote Sensing to prepare digital maps of vegetation change for 1973, 1978, and 1983 in the Thompson area. The Environmental Management Division reviewed and ground truthed the 1973 and 1978 maps and will be involved with ground truthing the 1983 maps. Experimental results indicate that LANDSAT Imagery provides a mapping capability suited for quantitative measurements of forest vegetation change from air pollution and other environmental effects.

Objective: To develop a provincial capability to use LANDSAT Imagery for quantitative monitoring of change to forest vegetation as a result of air pollution emissions from non-ferrous mining smelters in northern Manitoba.

Problem/Need: LANDSAT Imagery has been demonstrated to provide a useful monitoring capability to determine quantitative change to forest vegetation.

INCO Metals and EMD have initiated experimental work

through the Ontario Remote Sensing Centre; however, the Remote Sensing Centre of the Manitoba Natural Resources has recently received computerizing mapping equipment which can provide the desired capabilities for monitoring forest vegetation.

Quantitative mapping of change to forest vegetation in Flin Flon and Thompson areas is required to supplement federal/provincial (NoFRC/EMD) forest studies in the area and to provide a quantitative base for a long-term monitoring capability.

Once developed, a LANDSAT mapping capability for vegetation change to forest systems has potential to provide a quantitative means of defining impact from forest insect and disease outbreak as well as forest fires.

Resources:		
	* Technical position	$26.0
	* Operating & maintenance	$ 4.2
	TOTAL	$30.2

8.5 Project No. CM-10.5: Aerial Spraying of Herbicides - Indirect Effects on Wildlife Habitat

Background: In 1983, Abitibi-Price Inc. carried out aerial spraying of herbicides on 1303.5 ha. of forest land and a similar program is planned for 1984; initial field trials using herbicides are planned for MANFOR in 1984.

Herbicides are used to treat Spruce regeneration and plantations by releasing them from competition from herbaceous undergrowth and deciduous trees. The Environmental Management Division has a concern for the indirect effects of herbicide spraying on wildlife and similar concerns have been raised by the Northern Association of Community Councils, Inc.

Objective: To determine the indirect effects on wildlife and wildlife habitat from the aerial application of herbicides to control forest growth in Manitoba.

Problem/Need: In 1983, Abitibi-Price Inc. carried out aerial spraying of herbicides on 1303.5 ha. of forest land and a similar program is planned for 1984. MANFOR has submitted a Pesticide Registration Form to initiate field trials with herbicides on 73 ha. in 1984. Information is needed on the indirect effects of aerial spraying of herbicides on wildlife and wildlife habitat.

Resources: * Technical position - contract for 2 years $52.5

Operating & maintenance - 6.0 for 2 years $12.0

TOTAL $64.5